THE

FRANKLIN JOURNAL,

AND

AMERICAN MECHANICS' MAGAZINE;

DEVOTED TO THE USEFUL ARTS, INTERNAL IMPROVEMENTS, AND GENERAL SCIENCE.

MAY, 1827.

On Fire Engines, Hose, and some other apparatus manufactured and used in Philadelphia, for the purpose of extinguishing fires.

THE history of the origin, progress, and present state of the Engine and Hose companies in this city, is a desideratum, and were the facts respecting them carefully collected, and well detailed, it would be a very interesting article, and a document worthy of being preserved. Should we not be able to induce some one of our friends to undertake the task, we are determined to enter upon its performance ourselves, and shall be obliged by the attention of those who may aid us by furnishing any information upon the subject. We know of no city which can compare with our own, in the possession of the means for extinguishing fires, and the promptness and efficiency with which they are applied; nor of any association of individuals with larger claims to the gratitude and support of the community in which they live, than our Engine and Hose companies.

We have, in some of our former numbers, made extracts from Carey and Lea's edition of Nicholson's Operative Mechanic, and particularly of those parts which were furnished, for that edition, by the mechanics of our own country. The following article is of that description; we copy it as it appeared, and subjoin some observations from a correspondent, intended to correct such parts of it as he considers to be incorrect. EDITOR.

"Owing, perhaps, to the peculiar organization of the fire department of this city, (Philadelphia,) which is supported solely by the zeal and public spirit of private volunteer associations, with but slender pecuniary assistance from the city authorities, great emulation and rivalry exist, and the attention of ingenious men attached to

them has been directed to the improvement of the fire apparatus, and their exertions have been attended with corresponding success. The introduction of rivetted hose was perhaps the most important improvement in our means of extinguishing fires, and without it no apparatus should be considered as perfect. It is made of sole-leather dressed to an even thickness and breadth, lapped over and rivetted with iron or copper tinned rivets, which are introduced from the inside of the tube, has a burr placed upon its point which is then rivetted down, and closed with a hollow-set punch; the cross joints are secured diagonally, by a double row of rivets. Fifty feet thus made form a section, having at each end a screw, one male and the other female, turning upon a collar, and forming a swivel. An indefinite number of sections may be attached without twisting the hose. The merit of introducing the important improvement of rivetted hose, belongs to the Philadelphia Hose Company of this city, under whose direction and at whose expense the experiments were tried, and brought to its present state of perfection. The committee who executed the work were Messrs. Sellers, Pennock, and Morris.

Many important improvements have been made in the fire-engine also, especially in the form and arrangement of the various parts, and in the perfection of the workmanship.

Fig. 1. in the plate, exhibits a side view of an engine in the form preferred, and adopted, by most of our firemen. The levers are of a shape introduced by Mr. Perkins, and are by far the most convenient of any now in use. The handles hinge upon studs in the centre of the cross-bars attached to the end levers, and when put in operation fall into clasps at the extremities, and are there firmly retained. The improvement in the form of the levers was first made by Mr. Adam Eckfeldt.

Fig. 2. represents the working parts of the same engine. A A are the chambers or pumps, which are made of brass. The part in which the piston works is bored and polished; they are bolted down upon the seats M, which are in like manner secured to the bottom of the engine by bolts through the feet L. The pistons B B are two metal disks, each enclosed in leather, pressed into the form of a cup; the bottoms of these cups come in contact with each other, and the disks, and leathers, are firmly connected by the piston rods *n n*. The centre of the levers being permanent, these rods are made to work on a moveable pin P, and passing through the guide H, are alternately raised and depressed by the motion of the lever K, (a portion of which is represented,) moving upon its centre G. When the piston is raised the chamber fills with water, which is forced into it by the pressure of the atmosphere on the surface, through the opening in the seat M. It is then depressed, the valve *e* closes, and the water passes up through the water-way *c* into the air-vessel F, and is there retained by the closing of the valve, or until by the frequent and alternate operation of the pistons, the air in the air-vessel is so far condensed, that by its re-action it forces the water through the pipe O, on any object towards which it may be directed.

This engine is on precisely the same principle as Newsham's, and

differs only in the mechanical arrangement and structure, in which it is decidedly superior, being by far more simple.

Fig 3. represents another variation in the pump of the fire-engine, with the origin of which we are unacquainted, but believe it to be French. It consists of a cylinder of brass A A, laid horizontally, the piston working in the same direction, the rod being attached to drops, at right angles with the levers, which have the same form as those last described. When the piston is moved, the water follows by atmospheric pressure through the pipe, entering by the circular aperture J. On the return of the piston, the valve at P closes, and the water is forced through the water-way *o*, into the air-vessel K, its return being prevented by the closing of the valve *e*, it is discharged through hose leading from the pipe L. The same takes place alternately on moving the piston back and forward. The piston rod B, is a permanent rod of polished iron, working through the stuffing-box Q, attached to the cap *n*; *m* and *n* are cast-iron caps fitted to the ends of the chamber, and are rendered air-tight by leather, or leaden joints, securely connected together by bolts passing the length of the chamber, with a nut on each end. This description of engine is liable to some objections. It is, however, advantageously used in machines called *Hydraulions*, which are a combination of a hose-carriage and engine in one. It is compact, and can therefore be arranged so as to carry a large quantity of hose on the body, without making it too unwieldy. On the other hand, it is very liable to get out of repair, and difficult to put in order; in fact, to perform this operation, the whole works must come out. Again, owing to its position, all dirt and gravel that finds its way into it, naturally settles to the lower side, and wears that part away before any other; very soon making the chamber oval, and of course not perfectly water-tight. It is, however, well adapted to suctions, as the chamber being constantly full of water on both sides of the piston-head, no air can pass to destroy the effect.

Fig. 4. is a suction tube, on a new and improved construction, and is an admirable substitute for the leathern suction hose formerly used, possessing all its advantages without its defects. It is formed of copper tubes, *e*, *e*, *e*, five feet long, connected at each end by joints B, moving upon themselves, called swivel joints, thereby making the whole tube flexible. The pipe is here represented folded up in the form as carried on the engine, and may be extended at pleasure by unfolding the joints to the length of seventeen or eighteen feet. C is the female screw which attaches it to the outside of the engine, which is perforated, and furnished with a male screw; when thus fixed, it is forced against a leather collar within the aperture J in the suction-seat attached to the horizontal chamber, fig. 3. D, fig. 4, is a bulb of copper pierced with holes, which let the water pass, and excludes all dirt and other matter which would be injurious to the works of the engine.

Fig. 5. is a sectional view of Perkins's single-chamber engine. A is the working chamber, of copper, or brass, having small holes *d*, *d*, near the top, through which the water passes. B is a division cylin-

der between the chamber and air-vessel, and is firmly secured at the top, while the lower end terminates within three inches of the bottom of the chamber, and is intended to form the inner coat of the air-vessel. The whole is surrounded by a cylinder *c*, which forms the outer coat of the air-vessel, and is, at both ends, connected with the chamber by a plate formed of soft solder $\frac{3}{4}$ths of an inch thick, into which they are firmly incorporated. The whole stands upon a seat of brass, having an opening through which the water passes, and which is closed by the valve F. The chamber is firmly bolted to the top of the engine by bolts passing through the cap G, secured by nuts. K is the plunger of copper, made perfectly cylindrical, the capacity of which is half that of the chamber; it works through a stuffing-box *o*, *o*, made perfectly tight by bolts secured in the caps. J is the piston rod, moveable on the joint at M, which gives a perpendicular motion to the plunger. L is the piston head, through which is passed the cross-bar of the levers, which are similar to those first described. The operation of this engine is different from any other in use, or known by us, and was, we believe, a new idea of Mr. Perkins. Suppose the plunger or piston raised, water flows through the valve F by atmospheric pressure, and the whole capacity of the chamber below the plunger is filled. It is then depressed. The lower valve F closes, and those in the box *s s*, attached to the plunger, open. The plunger, we have already noticed, is exactly one half the size, or capacity, of the chamber; consequently, when the plunger is depressed, one-half the water which passes through the valve *s s* remains in the space between the chamber and plunger; the other half passes through the small holes *d d*, down the space between the chamber and division B, and thence through the discharge pipe N. When the plunger is raised again, the upper valve closes, the water which remained passes out through the same openings as before, and the chamber below the box is again filled, and the same operation is repeated at every stroke of the levers; thus a continued stream is sustained with one chamber, the water being projected both by the up and down stroke.

The only recommendation which can be given to this engine over the double chamber, is, that while the same effects are produced, the expense of the machine is decreased twenty per cent. But no form of engine is so simple, durable, or easily repaired, as those represented in figures 1 and 2.

The action of the *air-vessel* (F, fig. 2.—K, fig. 3.—C, fig. 5.) is well explained in the description of the operation of Newsham's engine, and is as follows:

The principles on which this engine acts, so as to produce a continued stream, are obvious: the water being driven into the air-vessel, as in the operation of common sucking and forcing pumps, will compress the air contained in it, and proportionably increase its spring, since the force of the air's spring will be always inversely as the space which it possesses; therefore, when the air-vessel is half filled with water, the included air, which, in its original state, counterbalanced the pressure of the atmosphere, being now compressed

FIRE ENGINE.

Merrick & Agnew, Makers.

Fig. 1. p 283

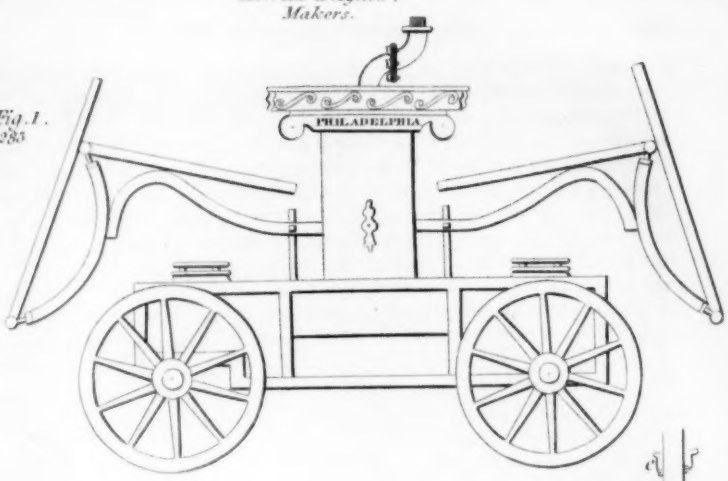


Fig. 2. p 283

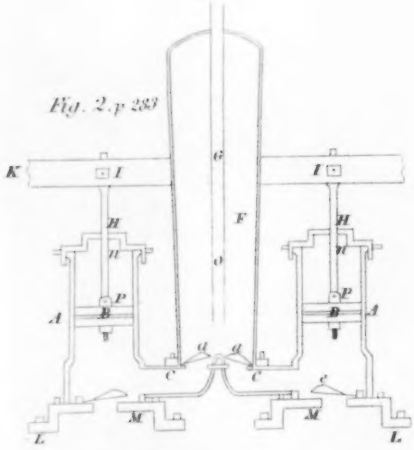


Fig. 4. p 284

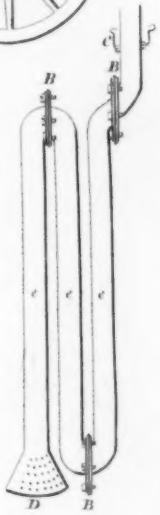


Fig. 3. p 283

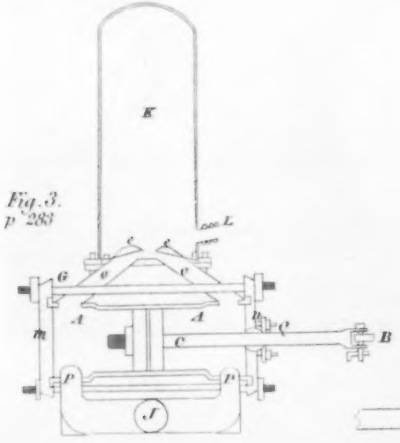
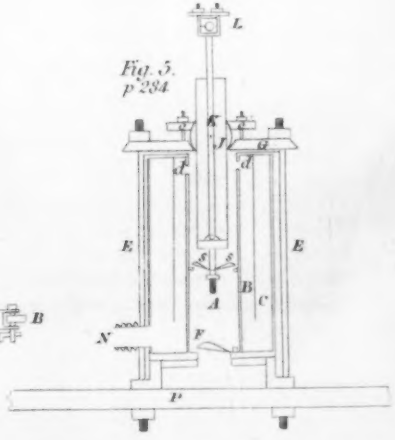


Fig. 5. p 284



into half the space, its spring will be equal to twice the pressure of the atmosphere; and by its action on the subjacent water, will cause it to rise through the conduit-pipe, and play a jet of thirty-two or thirty-three feet high, abating the effect of friction. When the air-vessel is two-thirds full of water, the space which the air occupies is only one-third of its first space; therefore, its spring, being three times as great as that of the common air, will project the water with twice the force of the atmosphere, or to the height of sixty-four or sixty-six feet. In the same manner, when the air-vessel is three-fourths full of water, the air will be compressed into one-fourth of its original space, and cause the water to ascend with the force of three atmospheres, or to the height of ninety-six or ninety-nine feet, &c. as in the following table:

Height of the water.	Height of the compressed air.	Proportion of the air's spring.	Height to which the water will rise.
$\frac{1}{2}$	$\frac{1}{2}$	2	33 feet.
$\frac{2}{3}$	$\frac{1}{3}$	3	66
$\frac{3}{4}$	$\frac{1}{4}$	4	99
$\frac{4}{5}$	$\frac{1}{5}$	5	132
$\frac{5}{6}$	$\frac{1}{6}$	6	165
$\frac{6}{7}$	$\frac{1}{7}$	7	198
$\frac{7}{8}$	$\frac{1}{8}$	8	231
$\frac{8}{9}$	$\frac{1}{9}$	9	264
$\frac{9}{10}$	$\frac{1}{10}$	10	297

There is not, however, as some suppose, any power gained by the use of the air-vessel; the only advantage obtained by it is, that the re-action of the condensed air serves to keep up a constant pressure on the water in the air-vessel, and sustains the stream perfect at the moment of the return stroke. The table showing the distance to which air of several degrees of condensation will project water, which closes the above quotation, may be very true in theory, but is not found to be so in practice, because the resistance of the atmosphere increases in a greater ratio than the velocity of the water; and beyond a certain distance the water cannot be projected, as it is found the resistance becomes so great as to disperse and separate the stream into small particles when projected with great velocity.

Operat. Mech. Am. Ed.

FOR THE FRANKLIN JOURNAL.

Observations on an article on the subject of Fire Engines and Hose, which appeared in the American edition of Nicholson's Operative Mechanic.

Mr. Editor—Having been informed that it is your intention to publish the article respecting Fire Engines, Hose, &c. which was furnished by some person in this city for insertion in Carey and Lea's edition of Nicholson's Operative Mechanic, I have thought that it would comport with your views, to admit into your Journal, some

remarks upon certain singular perversions, and evasions of fact, which exist in the statement there made; more especially as respects the introduction of the rivetted hose, by the Philadelphia Hose Company.

The writer of the article in question, says, that "the merit of introducing this important improvement, belongs to the Philadelphia Hose Company of this city, under whose direction, and at whose expense the experiments were tried, which have resulted in its present state of perfection. The committee who executed the work, were Messrs. Sellers, Pennock, and Morris."

Connected with the Philadelphia Hose Company from its origin, and well acquainted with its proceedings, I can safely aver, that the above statement is calculated to make impressions which are radically incorrect. I would be one of the last to detract from the credit due to that company. The improvement in question, and many others of great value, have arisen under its auspices, which have produced in a very prominent degree, the peculiar and improved system which now prevails in the extinguishing of fires. To it belongs the credit that the invention originated, and was perfected by members of the company, whilst it also stands in relation to it, in the interesting character of its original patrons. These, however, are the limits of its claims, as the invention must necessarily have had its origin in, and been consummated by the skill of, some individual mind, or minds. The reader of the above extract, fully aware of this, would be led to suppose, not that the Philadelphia Hose Company were the inventors, but that some one of its members, *not named*, had devised and dir-cted the plan, and that those of its members who *are named*, were merely the executive instruments,—the machine,—for carrying that plan into effect.

There is no foundation whatever for introducing the name of *Morris*, as one of the committee "who *executed* the work." The first suggestion of rivetting the hose, was made by Abraham Pennock, and the plan of forming the seam by a metallic connexion, by James Sellers. A resolution was then submitted to the company, for appointing a committee, to make, at the expense of the company, *such experiments* on the structure of hose, as *that committee* should deem adviseable. James Sellers, Abraham Pennock, and Jonathan Wainwright were appointed; the last named person has publicly disclaimed all participation in devising, or executing the work performed by the committee. Whatever credit therefore appertains to the inventors and executors of the improvement, belongs exclusively to the two members first named; a fact which has never been disputed by the company, and which has been indisputably proved before a jury.

The next item which I shall notice, is in the following words. "Fig. 3, represents another variation of the fire engine pump, the origin of which we are unacquainted with, but believe it to be French."!!

With respect to the engine, the following facts might readily have been ascertained by the writer of the above paragraph. William P. Morris, a member of the Philadelphia Hose Company, on observing

the compactness of Rowntree's fire engine, conceived the idea of fixing one of these engines on the same carriage with the hose; this idea he communicated to James Sellers, who arranged the plan, and prepared a model of this combined apparatus, which was approved, and adopted by the company. The existence of the embargo, frustrated the intention of importing an engine; and James Sellers proposed as a substitute, a cylinder similar to that described in the article, which proposition was also adopted. This invention, which originated out of a particular necessity, was variously modified in its details, as the execution of the plan progressed in the hands of the original proposer. It may also be observed, that the term HYDRAULION, now well understood, was invented to designate this novel machinery, of which this pump formed a striking particular.

As no stress is laid upon the position of the air vessel, though represented as vertical in the figure, it is merely necessary to remark, that though it so existed in the first hydraulion, it is not pursued, nor is it compatible with the present mode of constructing this combined machinery: in mere fire engines the erect air vessel is used. It is a *discovery of Sellers and Pennock*, that a *follower* or piston in the air vessel, effectually separating the air and water, is very advantageous in producing a uniform jet.

The article proceeds to state that "this description of works has some objections." Perhaps it is intended to confine these objections to what follows on the next page. "It is very liable to get out of repair, and difficult to put in order; in fact, to perform this operation, the whole works must come out." Now, the last mentioned circumstance is just as much the predicament of the double chamber engine as of this; and the prior assertion is *contrary to all experience*. The fact is, it is not so liable to get out of order as the pump on the old plan, because it is less complex; and any scientific man will assuredly come to the same opinion, on comparing the two plans, as exhibited in figures 2 and 3.

The article, in conclusion of these objections, states that "owing to its position, all dirt and gravel that finds its way into it, naturally settles to the lower side, and wears that part away before any other, very soon wearing the chamber oval, and of course not perfectly water tight."

The above paragraph conveys not merely a theoretical opinion, but a positive assertion that, conformably with the theory, a chamber whose position was horizontal, *has been* worn oval. The occurrence of such a fact is denied, and after the experience of so many years since hydraulions have been used, it may safely be concluded that it never will occur. The pump of the Phœnix hydraulion, is made simply of *sheet copper*, and has been in use about seven years. It has been probably used at almost every fire since it was built. Had the effect above described taken place, the cylinder must long since have burst. It remains, however, perfect and entire, and appears likely to remain a standing evidence of the fallacy of the foregoing theory.

It is difficult to conceive how any material which has gained access into the pump by *being suspended in the water*, and it must be

so suspended, either by its own levity or the agitation of the fluid, to get there at all, can be suddenly precipitated to the bottom, during the momentary period it remains in the pump, and while a continued agitation of the fluid is maintained by a rapidly moving piston. If it were necessary to show further, that the objection started has no solid foundation to rest upon, we might instance the pumps which have been in *daily use* for two or three years at Fair Mount water works, the position of these being horizontal, and no such effect having been produced.

In relation to the suction tube, fig. 4, it is the invention of Sellers and Pennock, and principally of Coleman Sellers, one of that firm. A description of it is given in the American edition of the New Edinburgh Encyclopædia, Vol. XVI, page 203. The difference in the manner of connecting the caps, is immaterial, and does not impair the claim of Sellers and Pennock, to be considered as its inventors.

On the preference which the article gives to the double chamber engine, over every other construction, I would, in conclusion, remark, that the double chamber engine has been long in use, has been well tried, and will perform well; and that any innovation in the form of a useful machine, will be regarded by the community with distrust; but it has a powerful competitor in the horizontal single chamber engine, which can be made *cheaper*, is more simple, and is equally substantial and efficient.

It is to be regretted that a work like that of Nicholson's, should have been chosen for the purpose of throwing into the shade, the just claims of individuals whose labours have been productive of public benefit; or of disseminating opinions which are erroneous, in consequence of the carelessness with which they have been collected.

SCRUTATOR.

ON THE NATURE AND PROPERTIES OF TIMBER.

Extracted from "The Elementary Principles of Carpentry, by Thomas Tredgold."

[Continued from page 149, vol. ii.]

Of the Structure and Classification of Woods.

To the experienced eye of a workman the general appearance of each variety of wood has become so familiar, and its most obvious characters are so strongly impressed on his memory, that he readily knows them one from another; but, nevertheless, the notice of some characters that are peculiar to certain kinds of woods may be of use, especially to young men, who will find both information and amusement in making collections of specimens, in examining their properties, and in rendering themselves familiar with their uses.

In a section of a tree it clearly appears that the wood is composed of separate layers, or rings, regularly disposed round the pith, which is in general nearly in the centre of the tree; but the thickness of these layers is seldom if ever perfectly regular.

When examined by a magnifier, the wood appears to consist of fine divisions, like rays, spreading from the pith to the bark, with pores between them, often empty, but sometimes filled with some kind of vegetable matter. In the resinous woods most of the pores are filled.

Besides the fine divisions, which are often scarcely to be distinguished by the naked eye, there are, in some woods, other divisions that are larger, like larger rays passing from the pith to the bark; they are generally of a light silvery colour, and are called the silver grain, or larger transverse septa. When a piece of wood is cut so as to pass obliquely through the larger septa, or silver grain, it produces that fine flowered appearance so well known in the oak.

The fine divisions, or lesser transverse septa, are common to all woods except the palm, though in some they are not very distinct; but there are only some kinds that have the larger septa, or silver grain;* therefore this forms a natural character for distinguishing the kinds of wood. And they may be divided into two classes, one that has, and the other that has not, the larger septa, or silver grain.

Again, in some woods, each annual layer or ring seems to be nearly uniform in its texture, and the line of separation between the layers is not very distinct, being so indistinct in some woods as to be "as it were shadows of circles, nothing real." Mahogany is an example of this structure; and the robinia caragna of Hill, is of this kind.

But in other woods, one part of the layer is nearly compact, and the rest of it presents the appearance of a circle of empty pores; of which we have an example in the ash. This structure is remarkably distinct in Hill's section of the arbutus.

There is a third kind, in which nearly all the pores appear to be filled with resinous or gummy matter; and one part of the layer consists of a compact, hard, and dark coloured substance, the other part is lighter coloured, and softer. All the resinous woods are of this kind.

According to these distinctions, the arrangement of the following table is made.

WOODS.	Class I.—With larger transverse septa.	*Division* 1.—Very distinct annual rings, one side porous, the other compact.	Oak.
		Division 2.—Annual rings not very distinct, and their texture nearly uniform.	Beech.
			Alder.
			Plane.
			Sycamore.

* As the term silver grain is used to denote both the smaller and larger septa, I shall follow the example of Mr. Ellis (Vegetable Anatomy, Supplement to the Encyclopædia Britannica, p. 332) and employ the terms larger transverse septa, and lesser transverse septa. I would rather have used the term silver grain; but if so, it must have been in a restricted sense, and in such cases new terms are less likely to mislead.

WOODS.

- Class II.—No larger transverse septa.
  - *Division* 1.—Annual rings very distinct, one side porous, the other compact.
    - Chesnut.
    - Ash.
    - Elm.
    - False acacia.
  - *Division* 2.—Annual rings not very distinct, and their texture nearly uniform.
    - Mahogany.
    - Walnut.
    - Teak.
    - Poplar.
  - *Division* 3.—Annual rings very distinct, pores filled with resinous matter; one part of the ring hard and heavy, the other soft and lighter coloured.
    - Cedar of Lebanon.
    - Larch.
    - Yellow fir.
    - White fir.
    - American pine.
    - Cedar.

The only properties of wood that seem to require explanation, are the cohesive force, the modulus of elasticity, the stiffness, the hardness and the toughness.

The *cohesive force* of a bar or beam is equal to the power or weight that would pull it asunder in the direction of its length. The weight that would pull asunder a bar of an inch square of different kinds of wood has been ascertained by experiments. Of these experiments I have taken the highest and lowest results for each kind of wood. Experiments have been made by Muschenbroek, Emerson, Rondelet, Anderson, and Barlow.

The *modulus of elasticity* is the measure of the elastic force of any substance. Dr. Thomas Young has by means of it given some very elegant demonstrations of the laws of resistance. As it is the measure of the elastic force, its use must be evident when it is considered that it is only the elastic force of timber that is employed in resisting the usual strains in carpentry; and the learned reader will readily perceive, that the constant numbers in my rules for the stiffness of timber, have for one of their elements, the modulus of elasticity.

By means of the modulus of elasticity, the comparative *stiffness* of bodies can be ascertained. For instance, its weight for cast iron is 18,240,000 pounds, and its weight for oak is 1,714,500 pounds. Hence it appears that the modulus for cast iron is 10-6 times that of oak, and therefore a piece of cast iron is 10-6 times as stiff as a piece of oak, of the same dimensions and bearing.

A *hard* body is that which yields least to any stroke or impressive force; and it may be shown, by the principles of mechanics, that in uniform bodies the degree of yielding is always proportional to the weight of the modulus of elasticity; therefore, a table containing the weights of the modulus of elasticity of such bodies, shows also their relative hardness and stiffness.

The relative hardness is determined with considerable accuracy by means of the modulus of elasticity; but the methods used for

ascertaining the hardness of mineral bodies is very defective; and the method proposed by Dr. O. Gregory, from the theory of percussion, is not susceptible of any tolerable degree of accuracy, from the difficulty of making correct experiments.

As the hardness follows the same laws as the stiffness, cast iron is 10-6 times as hard as oak. But it is necessary to inform the reader, that when the substance is not uniform, the hardness thus found is that of the hardest part. Thus, in fir, it is the darker part of the annual ring that is the hardest, and which determines the extent to which a beam will bend without fracture. Dry wood is harder than green, consequently it is more difficult to work. The labour of sawing dry oak is to that of sawing green, as 4 is to 3, nearly.

In respect to the *toughness* of woods, that wood is the toughest which combines the greatest degree of strength and flexibility; hence that wood which bears the greatest load, and bends the most at the time of fracture, is the toughest. From the data obtained in the course of my experiments, the comparative toughness has been ascertained; except in a few instances, where I had not specimens sufficiently long for experiments. In such cases Mr. Barlow's experiments have been calculated from.

The opposite to hardness, is softness, the opposite to toughness is brittleness, and the opposite to stiffness is flexibility; therefore, when the hardness, toughness, or stiffness of a wood is expressed by a low number, it may be considered to have the opposite quality.

I have made oak the standard of comparison, and have considered its strength, toughness, and stiffness, each to be 100; and in so doing, the mean strength of oak is taken at 11,880 pounds per square inch, and its modulus of elasticity at 1,714,500 pounds for a square inch.

Having thus laid before the reader the means adopted for arriving at the properties of the woods, I scarcely need say, that it is those properties which determine its fitness for the different purposes of carpentry. In some cases stiff woods are required, as in the joists and rafters of a building; in other cases tough woods should be employed, as for the shafts of carriages; and in other cases strength is necessary, as in ties, and other timbers strained in the direction of their length.

Tough woods, which are also hard, are the most difficult to work, especially if cross grained; on the contrary, brittle woods work easily: and hard woods preserve the best surface.

In general, where straightness is desirable, stiff woods should be preferred; where sudden shocks are to be sustained, tough woods are the best; where little strength is required, but much labour is to be put upon it, a brittle wood is desirable; and where a fine surface is to be preserved, a hard wood should be chosen: so that it is not in carpentry alone that these researches will be useful, for they are equally applicable to any art where timber is employed.

On the preparation of Catgut for various uses.

(Continued from page 225.)

CATGUT *for Rackets or Battledores.*—The intestines of sheep, after they have been steeped in the alkaline ley, are cut slantwise, if they are in short lengths, and sewed together; carefully placing the slants in a direction contrary to each other, that the seams may not render the cords of an unequal size. This being done, and the intestines formed into one piece, it must be soaked in ox-blood, to give it the proper colour, and then be stretched on a proper frame; after which, one, two, three, or four of the intestines, according to the required size of the cord, are fixed to a piece of tape, and the other ends are turned twice round a peg. This done, the workman takes the tape, applies it to a hook on a spindle, and gives a few turns of the handle. As the cord shortens by twisting, it must be well stretched; and when this is effected, the workman squeezes the cord between his finger and thumb throughout its whole length, to remove all its humidity, and produce an equal thickness in every part of it. One or two hours after, he twists it again, and rubs it with a horse-hair cord, wetted.

Thinner cords are made of only one intestine; operating as we have before indicated.

Catgut for Whip-handles.—Sheep's intestines, prepared with potash, are used for this purpose. The workman cuts them slantwise, and sews them together, observing always to keep them of an equal size. They are then stretched, and twisted at each end: it is very rare that this sort of cord is made of two intestines. They are then bleached, by the fumes of burning sulphur, once or twice; and sometimes coloured; as they readily receive any dye. Common ink is used for a black colour, and red ink for a rose colour, which is sometimes rendered lighter by a little sulphuric acid. A green colour is given by a composition sold for that purpose, by colourmen, to the manufacturers of catgut.

Catgut for Hatters' Bows.—These are made of sheep's intestines, of the longest and largest kind, after being prepared with potash, by twisting together, from four to twelve of them, according to the size required. They are usually made from fifteen to twenty-five feet long. During the twisting, the cord is placed in a long box, from eighteen to twenty inches in breadth, and a few inches high, in order to keep it clean, and prevent it from trailing on the ground. The box is called the *refresher.*

This kind of cord must be void of seams and knots; to accomplish which, the workman attaches the intestines to a piece of tape, hangs them on a peg, and draws the whole of them straight, to fit their other ends to another peg; in doing which, if he finds the intestines too short, he makes a hole in their ends, and threads into them short pieces, till the whole is long enough to reach the other peg, placed at a given distance from the first. These ends are then affixed to a piece of tape, and fastened to the peg. This done, he applies them

to the twisting-wheel, rubbing the cord well between his finger and thumb throughout its whole length, at every turn of the wheel, in order to make it of an equal size. When about half-dry, they are exposed twice to the fumes of sulphur; after each time, the cord must be well stretched, and moistened with plenty of the solution of potash, at the same time rubbing with the hair-rubber. It is then left to dry, and afterward cut, and coiled up for sale.

Catgut for Clockmakers.—This kind must be very fine, and of course requires the smallest intestines, well prepared with potash. Sometimes they are made by cutting, with a particular kind of knife, the intestine into two strips. The knife, which is fixed to a table, has two edges, in opposite directions; and above them, a ball of lead, which is introduced into one end of the intestine; and by drawing the latter continually over the ball, the projecting blades cut it into two strips, which the workman holds, one in each hand, drawing them regularly, till it be cut quite through.

Watch and clockmakers also use catgut of various sizes, consisting of more than one intestine, and made like the musical instrument cords, which we shall next describe.

Catgut for Musical Instruments.—Of all the cords from intestines, this kind is the most difficult to make, and requires the greatest care and ability of the workmen. It is acknowledged, that for many years they have been made as well in France as in Italy, with the exception of the treble-strings for violins, which our manufacturers have not been able to imitate, but on a very limited scale. This is owing either to the difference in quality of the intestines, or some other unknown cause. Whatever it be, we are still tributary to Naples for this article; and every exertion ought to be made to free us from this necessity. Experiments, made with skill, will no doubt succeed; and the Society for the Encouragement of National Industry, by calling the attention of artists to this subject, will have the glory of contributing to the perfection of an art, of which little is at present known.

The cleaning and scraping of the intestines for this purpose, to free them from the fat, must be done with much more care than is requisite for other cords, and when they have undergone that process, they must be steeped in an alkaline lye, prepared as follows:

An earthen pan, holding six quarts, is filled with water, and three pounds of potash are added to it, which must be well stirred, and suffered to subside. In a similar vessel, full of water, placed by the side of it, are put five pounds of pearlash, leaving that also to settle. If it be wished to make use of this solution within a short time, it will be necessary to add to it a little alum-water, which will clarify it quickly.

The scraped intestines are now put into earthen pans, so as about to half fill them. The pans are then filled up with the solution of potash, with as much water added, as to double the quantity of fluid. This liquid is changed twice a day, increasing its strength each time, by adding more of the solution of pearlash, and diminishing progressively the quantity of water, so that the last solution be the

strongest. The intestines gradually become whiter, and begin to swell. After having suffered them to macerate from three to five days, or more, according to the state of the atmosphere, the operation proceeds as follows—

Every time that the alkaline solution is changed, the pans are placed upon the box called the *refresher*, placed on a table, or on tressels, in a slanting direction, so as to facilitate the running off of the water. This box must be large enough to hold the frame on which the cords are to be stretched. The intestines are scraped with the edge of a copper-cube, held in the left hand. The forefinger of the left hand is placed near to the edge of the copper-cube; whilst, with the right hand, each intestine is drawn over the edge of the disk, or cube, and between the forefinger.

When they have all been treated in this manner, and placed in a fresh pan, a stronger alkaline solution is poured on to them than that from which they were last taken, as we have before mentioned. This operation is necessary for cleansing the intestine of its greasy quality, and bringing the cords to perfection.

As soon as it is perceived that the intestines begin to swell, and some little bubbles appear on their surface, (for in this state they rise in the water,) it is necessary to twist them *immediately*, or they will begin to shrivel, which sometimes happens, particularly in summer, and occasions the loss of the intestines, and also the time spent over them. In hot weather, the intestines are, indeed, most easily cleaned from fat; but then the workman must be more than ordinarily attentive, and the different leys for the washings must be made stronger with alkali, and applied more quickly. In winter, all goes on in better order, and the operation is more certain. The manufacturers of this article generally place their workshops in cool places, where there is a little dampness.

The intestines being now ready to be twisted, they are taken out of the alkaline solution. Some manufacturers plunge them again into fresh water, and wash them well therein; but, although they become by this method of a better colour, and take the sulphur better, they run the risk of being weakened.

To twist and finish the cords, a machine is used—a kind of frame, two feet high, and five feet long; on one end of which are placed a number of pegs, and in the opposite end are bored, with a large auger, a number of holes, inclined in such a way, that when pegs are placed in them, to attach the cords to, they may not be liable to slip and come out. The intestines are now selected, according to their size; and two or three of them are taken, and the ends twisted round one of the pegs first placed, and the other ends are carried to the opposite ones, and attached to them. Two turns of the intestines around the pegs, are sufficient to prevent their slipping. When fixed to the pegs, they must not be drawn tight, as they would be subject to snap during the twisting, if sufficient play were not given to them for that operation.

If any of the intestines should be found too short to reach the opposite side of the frame, they must be lengthened, by pieces cut off

any others which may be too long; and care must be taken to make the ligature near the last-placed peg, to preserve the cord of an equal size in its whole length, as otherwise it would be false in its tone.

The frame being filled up in the manner we have described, two or three of the pegs, bearing one end of the intestines, are fixed to spindles, if the machine contains several, and turned round several times, passing the finger and thumb of the left hand frequently from one end of the cord to the other, beginning at the spindle. When all the cords have undergone this operation, and the pegs are all replaced, the whole frame is placed in the sulphuring closet, with several others, as it would not be worth while to sulphur one at a time.

The sulphuring closet is placed in a damp place, surrounded as much with water as possible. An earthen vessel, containing the sulphur, is placed in it, with the frames; the sulphur is then set on fire, and the closet well closed in every part, to confine the fumes. When the cords have remained a sufficient time—which, of course, varies in some measure, according to circumstances—the frames are taken out, and placed on the *refresher*, and rubbed with a horse-hair cloth. This done, they are again placed in the frame, twisted anew, and returned to the sulphuring closet, to undergo the same process as before. If the state of the atmosphere require it, the whole of these processes must be twice or thrice repeated; and they are then left to dry.

When the cord is sufficiently dry, it is known by its not running up when a peg is taken out, and remaining stiff and straight, instead of flagging. If dry enough, they are well oiled with good olive oil, and coiled up into rings for sale. They become better by being kept some time.

To make the fourth strings for violins, or any other sized cords, intended to be covered with metal wire, the process is so well known, that it need not be here described.

The whole success of these operations depends principally on the ability and experience of the workmen, in managing the different washings, stretchings, and twistings, and in a judicious use of the sulphur. When the cord is too much sulphured, it readily snaps; and, on the contrary, when it is not enough so, it stretches too much, and never keeps in tune.

We may conclude, that there is no fixed rule yet adopted for the success of this branch of manufacture: but we have much expectation, that, with the aid of the Society for Encouraging National Industry, we should soon succeed as well as the Italians.

FOR THE FRANKLIN JOURNAL.

MECHANICAL JURISPRUDENCE.—No. XVI.

BY PETER A. BROWNE, ESQ.

On the Law of Patents for new and useful Inventions.

JOINT AND SEVERAL PATENTS.

We shall now proceed to inquire into the nature of joint, and several, patents, and the effect of taking out the one, or the other of them.

In the first place, *there may be a joint patent for a joint invention.*

In the case of Barrett *v.* Hall, 1 Mason's Reports, 472, this rule is laid down. Judge Story says, "A joint patent may be well granted upon a joint invention. There is no difficulty in supposing, in point of fact, that a complicated invention may be the gradual result of the combined mental operations of two persons acting together, *pari passu*, in the invention. And if this be true, then, as neither of them could justly claim to be the *sole* inventor in such a case, it must follow, that the invention is joint, and that they are jointly entitled to a patent. And so are the express words of the patent act, which declares, that if any person or *persons* shall allege, that he or *they* have invented, &c. a patent shall be granted to him or *them* for the invention."

The statute of James, also, speaks of "inventor or inventors," thereby implying that there may be *joint* inventors. I have not been able, however, to find in any English adjudged case, that a joint patent may issue to joint inventors; but it is common in practice, to issue patents to two, or more, persons; the correctness of which practice does not appear to have been disputed.

The next rule is, that *a joint patent cannot be sustained upon a sole invention.*

For this, we must refer to the same authority as the last. "A joint patent," says Judge Story, "cannot be sustained upon a sole invention of either of the patentees; for the patent act gives no right to a patent, except *to the inventor;* and requires an oath from the party who claims a patent, that he is the *true inventor.*

And it is equally clear, that *the same persons cannot, at the same time, hold, jointly and severally, valid patents for the same invention.*

The reasoning of Judge Story upon this rule, is conclusive. He says, (in the case last cited,) "In the next place, a joint patent for an invention, is utterly inconsistent with several patents for the same invention by the same patentees. For it is impossible, that any person can be, at the same time, the joint, and the sole inventor of the same invention. If, therefore, each of the joint patentees obtain a several patent for the same invention, as his own exclusive invention, and afterwards, without surrendering the first patent, they obtain a joint patent for the same as a joint invention, either the former sole patents are void, or the joint patent is void. For, besides the apparent inconsistency of the patents, if *all* could be sustained,

then a recovery upon the joint patent would be no bar to a suit upon the several patents; and the parties might obtain a double recompense for the same infringement. There is an additional reason, which deserves great consideration; and that is, that if sole and joint patents could be sustained by the same parties for the same invention, they might be *successively* taken out, so the term of the exclusive right might be prolonged for a great length of time, instead of being limited to fourteen years."

In the case of Odiorne *v.* The Amesbury Nail Factory, 2 Mason's Reports, 28, we have a decision supporting this reason. Jesse Reed had obtained a patent in September, 1810, for a machine for cutting, griping, and heading nails; and he afterwards, in 1814, obtained a patent substantially for the same invention, the first patent remaining unrepealed. Upon this objection being taken, Judge Story said, "It cannot be, that a patentee can have in use, at the same time, two valid patents for the same invention; and if he can successively take out, at different times, new patents, for the same invention, he may perpetuate his exclusive right during a century; whereas the patent act confines his right to fourteen years from the date of the first patent. If this proceeding could obtain countenance, it would completely destroy the whole consideration derived by the public for the grant of the patent, viz. the right to use the invention at the expiration of the term specified in the original grant."

If joint inventors, by mistake, take out separate patents as for separate inventions, they are not thereby, afterwards, upon discovery of the mistake, absolutely estopped from taking out a joint patent for the same invention.

The following extract from Judge Story's opinion, in Barrett *v.* Hall, 1 Mason's Reports, 474, which, although not expressed with his usual clearness, will, it is apprehended, establish this position. "In the next place, if several patents are taken out by several patentees for several inventions, and the same patentees afterwards take out a joint patent for the same, as a joint invention, the parties are not absolutely estopped, by the former patents, from asserting the invention to be joint."

The acceptance of the subsequent grant of the second patent is an estoppel to the patentee to set up any prior grant for the same invention, which is inconsistent with the terms of the last grant.

For this rule, we must still have recourse to the opinion of Judge Story, in the case last mentioned. He remarks, "I am, therefore, clearly of opinion, that the grant of a subsequent patent for an invention, is an estoppel to the patentee to set up any prior grant for the same invention, which is inconsistent with the terms of the last grant."

In the cases mentioned in the rule respecting a patent taken out by mistake, it is *doubtful* whether the second patent can issue until the first be repealed, as void.

This doubt is suggested by Judge Story, in the manner following: "And I have very great doubts, whether, when a patent is once granted to any person for an invention, he can legally acquire any

right under a subsequent patent for the same invention, unless his first patent be repealed for some original defect, so that it might truly be said to be a void patent." While the first patent stands unrepealed, it is very strong evidence against the second patent.

SEPARATE PATENTS FOR THE SAME INVENTION.

A person cannot hold, at the same time, two separate patents for the same invention.

In the case of Odiorne *v.* The Amesbury Nail Factory, 2 Mason's Reports, 31, Judge Story adds to what was before quoted, the following sentiment: "I hold it to be the necessary conclusion of law, that the inventor can have but a single *valid* patent for his invention; and that the first he obtains, while it remains unrepealed, is an estoppel to any future patent for the same invention, founded on the general patent act. The public have, by the first patent, acquired an inchoate interest, which cannot be defeated by any merely *ministerial* acts of the officers of government." This was also decided in Huntington *v.* Morris, MS. Rep. C. C. U. S. New York, Thompson, Justice.

The next question is, whether it is not a valid objection to the second patent, that the patentee had a prior patent for the same thing, not surrendered, repealed, nor declared void. This objection cannot be surmounted; a prior patent must be got rid of, before a second can be taken out. Why should a second patent be taken out, before a prior one is avoided, although invalid, if the patentee was enjoying the full benefit of it? It is objected, that the patentee is in difficulty as to getting the first patent out of the way. But if the patentee should sue on the first patent, and the defendant should succeed in the suit, the patent would be declared void: and if the patentee had a right to the thing pretended, the objection to a prior patent would be removed.

THE KIND OF PROPERTY WHICH THE PATENTEE HAS IN THE INVENTION, AND IN THE PATENT.

In the United States, the inventor has a property in the invention, before the patent is taken out.

The act of congress does not, as before shown, *grant* him any thing, but *secures* to him the enjoyment of a pre-existing right.

This would also appear to be the rule of the English law, notwithstanding what is said of its being the free gift of the king; for if the inventor agree to inform another person of the secret, who binds himself in a penalty, not to avail himself, or take any advantage, of the communication, he may maintain an action for the breach of that contract.

Dickenson applied to Smith, to obtain a knowledge of his invention, and agreed, under a penalty of one thousand pounds, that no undue advantage should be taken of the communication made. Dickenson then entered a caveat, to prevent any one but himself taking

out the patent. He afterwards obtained a patent in his own name, but being unable to make out the specification, he obtained information from Smith, under an assurance, that he would take no advantage of the communication. He afterwards used the patent as his own invention; upon which, Smith sued for the penalty, and recovered.

The property which an inventor has in his invention, before a patent taken out, is inchoate, and imperfect.

Canham *v.* Jones, 2 Vez. & Beam. 221, was a bill, complaining of an imposition on the public, of a spurious composition, under the same name as the complainant's medicine, to the secret of which he had a legal right from the original inventor: but there was no patent. The defendant had judgment on demurrer.

The invention, before a patent taken out, would not pass under a commission of bankruptcy.

Hesse *v.* Stevenson, 3 Bos. et Pul. 565, was a case of an uncertificated bankrupt, who, after commission issued, took out a patent. In page 577, Lord Alvanley, C. J., says, "It is true, that the schemes which a man may have in his own head, before he obtains his certificate, or the fruits which he may make of such schemes, do not pass, nor could the assignees require him to assign them over, provided he does not carry his schemes into effect, until after he has obtained his certificate."

The first section of the act of 1793, declares, that the exclusive right shall be granted to the petitioner, or petitioners, his, her, or their heirs, administrators, or assigns: and the printed form of patents used at the patent office, conforms to this provision, inserting the word "*heirs*," and leaving out the word "*executors*." In the fifth and tenth sections, the word *heirs* is omitted, and the word *executors* appears: from which, I infer, that the word *heirs* was introduced into the first section by *mistake*. Be that, however, as it may, it is certain, that the patent is *personal* property, passing into the hands of the executors, and not into those of the heir.

The English statute mentions only the inventor, or inventors; and yet the patent always issues to him, or them, his, or their, executors, administrators, and assigns.

It was, in one case of O'Reilly, 1 Vez. j. 129, doubted by Lord Thurlow, whether letters patent could be the subject of a trust; but I agree with Mr. Godson, that it may. The English patents stipulate, that they shall not be assigned in trust to more than five persons.

THE TRANSFER OF THE PATENTEE'S RIGHT.

The next subject which demands our attention, is the transfer of the patentee's right.

It would seem, that *the inventor, or discoverer, may transfer his right, before a patent issued, and the assignee may take out a patent.*

The first section of the act of congress declares, that the exclusive right shall be granted to the petitioner, or petitioners, his, her, or their heirs, administrators, or *assigns*.

The inventor, or discoverer, may take out a patent, and assign it afterwards.

The fourth section of the act of congress states, "That it shall be lawful for any inventor, his executors, or administrators, to assign the title and interest in the said invention, at any time; and the assignee having recorded the said assignment in the office of the secretary of state, shall thereafter stand in the place of the original inventor, both as to right and responsibility; and so the assignees of assigns, to any degree."

The fifth section gives an action, if the invention is used by any one, without the consent of the patentee, his executors, administrators, or *assigns*.

The tenth section says, that the application to repeal a patent, shall be made to the judge of the district court, where the patentee, his executors, administrators, or *assigns*, reside; and directs the process to issue against the patentee, or his executors, administrators, or *assigns*.

In English patents, there is always inserted a condition, that, if the patentee shall make any transfer, or assignment, of it, or divide it into shares, or declare any trust, or seek public subscriptions, or shall presume to act as a corporate body, or do any thing contrary to the act of Geo. 1. so that more than five persons should in any manner become interested, and claim a benefit in the patent, it is declared void.

Under this condition, it has been decided, that executors and administrators, however numerous, being considered in law as one person, shall be entitled, in right of their testator, or intestate.

The patent, if taken out, passes under a commission of bankruptcy. Hesse *v.* Stevenson, Lord Alvanley, in 578.

A patentee may give licenses to persons to use his invention. Godson on Patents, 169. Tyler *v.* Tuel, 6 Cranch, 324.

The patentee, after an assignment of his interest, cannot set up an allegation that the patent is void.

In the case of Oldham *v.* Lanymead, cited by Lord Kenyon, in Hayne *v.* Maltby, 3 Term Reports, 439, 441, the patentee had conveyed to the plaintiff, his interest in the patent; and yet, in violation of his contract, he afterwards infringed the plaintiff's right, and then attempted to deny his having any title to convey. But Lord Kenyon was of opinion, that he was estopped, by his own deed, from making that defence.

An assignment, in order to entitle the assignee of the patent right to sue in his own name, alone, must be an assignment of the whole right.

Tyler *v.* Tuel. In the Circuit Court of the District of Vermont in 1804. The plaintiff was assignee of another, Tyler, the original patentee; and the suit was for a violation of the patent right. The assignment, set out in the record, was of all the right, title, and privilege, in any part of the United States, excepting in the counties of Chittenden, Addison, Rutland, and Windham, in the state of Vermont. After verdict for the plaintiff, a motion was made, in arrest of judgment, founded on the insufficiency of the plaintiff's title, as

set forth. On this question, the judges were opposed in opinion. The cause was removed to the Supreme Court of the United States, who arrested the judgment. According to their directions, the following opinion was certified to the Circuit Court for the District of Vermont: "It is the opinion of the court, that the plaintiffs, by their own showing, are not legal assignees to maintain this action, in their own names, and that the judgment of the Circuit Court be arrested."

The original patentee may assign a moiety of the patent right to another, who, with the patentee, may maintain an action in their joint names for an infringement of the right.

The king of England granted a patent to James Watt, for the sole benefit, &c. of his invention for lessening the consumption of steam, &c. and an act of parliament was afterwards passed, extending this benefit for 25 years, to Watt and his assigns. Watt assigned two thirds of this patent right to Boulton, and Boulton and Watt sued Bull for the violation of this patent. But although the case was disputed with great professional skill, the objection that Watt could not assign a part to Boulton, so as to enable them to sue jointly, was not taken.

This point was decided in the case of Whittemore *v.* Cutter, 1 Gallison's Reports, 429. It was an action for the violation of a patent right for the making of cotton and wool cards, brought jointly, by the original patentee, and his *assignee*, of a moiety of the right. After verdict for the plaintiff, it was moved that a new trial should be granted, on this, among other grounds, that the action could not be maintained in the above form. Story, justice, gave his opinion as follows: "The first objection is founded on the incompetency of the plaintiffs to maintain the present action; one of the plaintiffs being the *original patentee*, and the other an *assignee* of a moiety of the patent right, deriving his title under the patentee. It is contended, that no action will lie in this court, for an infringement of a patent right, in favour of an assignee, unless he be the assignee of the *whole title and interest*. And the language of the 4th sect. of the Act of 21st February, 1793, ch. 11, and the case of Tyler and al. *v.* Tuel, are relied on in support of the position."

"It is true, that a party relying on an action given by a statute, must bring himself within the provisions of the statute. But where, as in the present case, the law is *remedial*, it should have a *liberal* construction, to effectuate the intentions of the legislature. Upon the very rigid construction, which is assumed by the defendant's counsel, an action could not be maintained, where a joint patent should be obtained by two persons, and one of them should assign his whole interest. The action could not be *jointly* brought by the patentees, because one would have parted with his whole interest, nor *jointly* by the patentee and the assignee, for it would then be open to the very difficulty which is pressed upon us in this case: nor by either party *separately*, for it would be splitting the cause of action. Other cases might be put, in which the parties would be wholly without remedy. We are well satisfied, however, that the direction

given at the trial, on this point, was correct. The statute gives to the assignee *all* the right and responsibility, which the original inventor had in the undivided portion of the patent, which is conveyed; and an action may well be maintained by *all* the parties, who, at the time of the infringement, are the holders of the whole title and interest. The case of Tyler and al. *v.* Tuel, is clearly distinguishable. In the first place, it was brought by persons who did not purport to have the whole patent right in themselves. In the next place, there was, technically speaking, no *assignment* of the patent right. The instrument could only operate as a *covenant*, or *license*, for the exclusive use of the patent right in certain local districts. But a patent right itself is unsusceptible of local subdivision. Nor is the present case within any of the mischiefs which were pressed on the court in that case. The language of the 4th sect. does not seem to have contemplated the case of joint inventors; yet there can be no doubt that being within the *reason* of the clause, they must be held within the *purview*. If either should die, can there be a question that the executor or administrator might well maintain an action jointly with the surviver, for an infringement? And in what substantial respect can an assignee in law, be considered as distinguishable from an assignee in fact? Upon the most mature reflection, we are satisfied, that this objection cannot prevail *upon the footing of the statute;* and if urged at common law, the case of Bolton and Watt *v.* Bull, where the action was brought by the inventor and his *assignee* of two thirds of the patent, would afford a complete answer.

THE PRIVILEGE GRANTED TO THE PATENTEE.

The privilege granted by the English statute, is the sole working, or making of any manner of new manufacture.

The act of congress secures to the patentee, the full and exclusive right and liberty of making, constructing, using, and vending to others to be used, the said invention, &c.

The English statute, limits the period to 14 years. The words are "For the term of 14 years, or under."

The act of congress says, "For a term not exceeding 14 years."

Statutes are sometimes made in England, to extend the time of exclusive privilege. Godson on Pat. 148 and 158; so also have acts of congress been obtained, enlarging the time.

The time when the 14 years are to commence, is expressly stated in the statute; the words are, "the said fourteen years to be accounted from the date of the first letters patent or grants of such privilege."

On this subject the act of congress is silent. Judge Thompson, in the case of Huntington *v.* Morris, MS. Rep. C. C. U S. for the southern district of New York, seemed to think this discrepancy material to the construction. He said, that it appeared to be the settled law of England, that if an invention had been introduced into use *by the patentee himself*, and made known and used by others before the date of the patent, such disclosure and use would destroy the patent. That there was, however, a difference between the

English law and the act of congress on this subject. *In the English statute, it is stated precisely from what period the* 14 *years are to commence—they are to run from the date of the patent; there is no such phraseology in the act of congress.*

On cheap and easy methods of preventing Houses from tāking fire, and on the necessity of establishing regulations to enjoin the adoption of some means of this nature in the Metropolis. By Mr. J. W. Boswell.

(Concluded from p. 170.)

That staircases should be made fire-proof, is also very important to the safety of a family; it is difficult to conceive, why the expense of cut stone should be so very much higher here than in France; I have seen in Lyons, complicated and difficult work of this nature executed, which would not have been attempted, had it cost a tenth of the price that would be charged in England; I shall only mention a single instance, which is the slab of a balcony, about ten feet long, and four feet broad, with two brackets, more than three feet each way, connecting it with a block of equal dimensions to the slab, and at right angles to it, which was to form part of the front wall of the house; and from which latter, another piece projected in the opposite direction to that of the brackets, intended to be built up in a party wall, and all this cut out of a single block of stone, and designed for an ordinary house in one of the new streets in the quarter Perrache. Stone stairs at first would, for the above reason, be rather expensive here; but it is probable, if there should be a considerable demand for them, that machinery would be applied for sawing out steps for them, near the stone quarries, which would cause them to be sold at a reasonable price. But we are not confined to the use of cut stone, for this desirable purpose; stairs may be made of plates of cast iron, supported by wrought iron traverses; of which sort of stairs, a neat specimen has existed for many years, in front of the late Duke of Queensberry's house, in Piccadilly. Stairs of this species, well painted, would look very well, and when carpeted, would scarcely be noticed as extraordinary. A cheaper kind than these might be made from slabs of the large, thick slates, found in Cumberland, sawed out for the purpose, and fastened by screws to wrought iron traverses; these, if carefully made, would also look very well, when painted; and of their strength there could be little doubt, after its having been proved, on good authority, that slate one inch in thickness, will support, in a horizontal position, as much weight as Portland stone, five inches thick, of the same length and breadth. Staircases might also be made, as in France, of a compound nature, of tiles, or thin slabs of stone, plaster, and wood, united; which, though not so good as those mentioned, would, however, be very little, if at all, liable to catch fire, and would be vastly more secure than our deal stairs: small, thin ledges of cast iron, at the projecting angle of each of these stairs, would improve their durability, safety,

and appearance, and would add but little to their cost; and when constructed in this manner, with thin slabs of stone, painted, forming their upper surfaces, might be made to look very handsome. The landing places for these stairs might be made fire-proof in the same manner as the floors of the rooms, and be covered over with slabs of stone, or with tiles, whichever would best correspond with the nature of the stairs.

The floors are evidently of the first importance to be secured from fire, since the fire almost invariably commences with them, when a house is burned down; next to these, the stairs demand attention in this respect, as a means of escape; and after them, the partitions between the rooms should receive notice. These latter should never be made entirely of wood, particularly in rooms where servants sleep; and even lath and plaster partitions, though not so dangerous, ought, however, to be superseded, for greater security, by partitions of four inch brick walls, vulgarly called *brick noggin*, which, in some places, cost less than those last mentioned, and no where much more. Many houses have been burned by servants sticking candles against wooden partitions, which custom, filthy, dangerous, and unpardonable as it is, particularly in houses where candlesticks are in abundance, will still be found practised sometimes even there; and this danger, added to the ready means which they form of conveying the flames from one floor to another, should exclude the use of wooden partitions, and of those of lath and plaster, from all houses desired to be in a state of security against the most tremendous of worldly calamities.

The means pointed out for securing houses against fire, would at least diminish the danger from accidents ninety-nine parts in a hundred; and would even make it extremely difficult for intentional incendiaries to succeed in their diabolical designs; and if not absolutely such as would put them beyond the possibility of conflagration, at least, would render the probability of this dreadful event so very minute, as to place it on a par with the numerous other probabilities, to which our lot, as mortals, subjects us, and which no human prudence can avert. But the pointing out these means, and endeavouring to impress the importance of the subject on the mind and the heart, I am well aware, can but form a small step towards the removal of the evil; and all my hope from doing so, is, that it may engage the attention of the numerous classes who have already suffered from fire, either by the loss of friends, or of property, to induce some of them to unite in the only effectual means for preventing the great frequency of its occurrence.

Those who inhabit houses, seldom have had any concern in building them; and those who build them to let again, merely consider the profit of the speculation, and think the insurance sufficiently covers their part of the risk of fire: and though I think it might be proved to them, that in making houses fire-proof, by the cheap and easy means mentioned, their profits would not be diminished; that the diminution of the value of insurance, which it would soon occasion, would more than counterbalance any small additional expense which

might occur in first bringing it into practice; and that, besides, they would increase their chance of getting a better rent for houses so secured; yet, for many reasons, which must be obvious to those who know the habits and other circumstances of master carpenters, and master bricklayers, of which classes a large majority of builders consists, to attempt to change their methods, in any respect, or even to persuade them that it was possible they were not the best that could be, would be a task no less hopeless than irksome.

Should an act of parliament be passed, compelling, by sufficient penalties, the owners of all houses, the floors of which were not laid before six months after it had obtained the royal assent, to cover the joists of the floors with an adequate coat of plaster, at least as thick as that used for the same purpose in Paris, and prohibiting the use of boards above that coat of plaster, forbidding the construction of wainscot, or wooden partitions, or those of lath and plaster, and enjoining that the stairs should be made fire-proof in some of the modes mentioned, or in some other manner equally safe, it is almost certain, that in fifty or sixty years afterwards, the conflagration of a house in London would be a much more rare occurrence than even in Paris, where it happens so very seldom, notwithstanding the much greater negligence of the people there respecting fire, the greater risk attending some of their methods of cookery, and the increased danger from their using wood for fuel in their apartments.

Of Plasters, or Stuccos, for retaining Water. By M. Hassenfratz.

As cisterns are intended to contain water, the principal condition necessary for the mortar with which they are to be plastered, is, that it should be unattackable by water; it is, therefore, needful, that that these mortars should be good (*betons*) aquadurant cements. Delafaye proposed to form them of one part of lime, slacked dry, and of two parts of chippings of stone, &c. It would appear, that, in pointing out this composition, he has reckoned much on the advantage which dry slacked lime might produce; but what effect would be caused by this method of slacking on rich lime, has been already explained. For the rest, it is extremely easy, as we have observed in treating of *betons*, to procure in every country, excellent mortar for works of this nature. For this purpose, it would be necessary to provide a good lime that hardens in water, either natural or artificial, or to make mortar of rich lime with pozzolana, baked clay, cinders of fossil coal, &c., which will render this lime insoluble in water: finally, in mixing and triturating, with the lime which can be obtained, those substances which will form with it excellent *betons*, it is necessary, farther, to take every precaution, in using these mortars, to favour their setting. For some of these plasters, the cisterns should be speedily filled with water; for some others, it is necessary that the mortar, or *beton*, should be perfectly set, before the intro-

duction of the water. These last *betons*, which require a time, more or less long, to set, or which harden and set at once easily in the air, ought to be preferred; because it is always essential, that the plastering should be completed, before the water is admitted into the reservoir, and that this plaster should take a time, more or less long, before being finished.

While the plaster is exposed to the air, and has not entirely set, it is good to compress, beat, and consolidate it, to prevent crevices being caused by its contraction, and to diminish the bulk caused by its desiccation; it is also no less necessary, to cover it, to prevent its drying too speedily.

At Paris, for a long time, the lime of Senonches was used in the composition of mortars for plastering cisterns, and other reservoirs for water; at present, the artificial lime of M. de Saint Leger, of which we have before written, is preferred; as it hardens more in the water, and costs much less. Besides, in ordering it from M. de Saint Leger, lime hardening (in water) in several different degrees, can be obtained.

If, however, it should be apprehended, that *betons* made with artificial hardening limes would not retain the water powerfully enough, *betons* may be composed with rich lime, and baked clay, in proper proportions, and a little molasses may be also added to the composition.

Of Badigeon, (wash, or thin plaster.)

The name of badigeon, is given to a composition, either white or coloured, which is applied on the exterior surfaces of buildings, and in which lime is commonly the principal substance; it is one of those compositions which are of great solidity, on which paintings in *fresco*, more or less valuable, are executed as upon stucco. Fresco paintings on the front of houses, or of other edifices, are very common in Italy; and some are found there, which are very ancient, and of which the badigeon, or stucco, on which they were executed, must have had a great solidity.

The most simple badigeon, which is most commonly employed, is composed of slaked lime, diluted with water, to which alum or butter-milk is added, and which is laid on the walls with a brush: to this wash of lime and alum, different substances are added, according to the colour which it is required to possess; half a pailful of sawings of stone, with a larger or smaller proportion of street-ochre, are mixed with it, when a stone-colour is desired to be painted; and charcoal-black, or lamp-black, is added, when it is intended to give to the walls the appearance of antiquity, &c. The proportions for a stone-colour, are, a pailful of slaked lime, half a pailful of sawings of stone, and a pound of alum.

In Spain, for a long period, a mixture of serum of blood, and slaked lime, has been employed for colouring the outsides of edifices; this composition adheres firmly, and, when it is dry, resists for a long time the action of water; the serum of ox-blood, alone, decanted immediately after the formation of the coagulum, and applied on soft

stone, gives it a yellowish tinge, and resists water, when it becomes dry. The best manner of employing the serum, is to grind it with roach lime; when this last is slaked, it is passed through a sieve, and a paste is formed with it, which, diluted with serum, and immediately after laid on the stone, covers it very equally, and gives it a yellowish colour, according to the greater or less quantity of colouring particles, which remain in the serum: two coats of this colour are often necessary, and sometimes, three. This paint is neither injured by rubbing, nor by washing with water. This composition has been for a long time used in China. The fixedness of this kind of painting depends on the state of the serum. This substance corrupts so readily, that it must be employed in a day, or, at most, in twenty-four hours, after it is procured; for as soon as the putrid odour becomes perceptible, the painting obtained from it, either separates in scales, or falls off in dust.

For a long time, a white pigment has been used, composed of the caseous part of milk, and lime. M. Bachelier, the son, has announced that his late father employed a similar composition for his preservative badigeon; but the analysis made by Vauquelin, of badigeon, taken from columns, to which it was applied by Bachelier, the father, produced the following result:

Carbonate of lime,	63.00
Sulphate of lime,	7.73
Carbonate of lead,	6.00
Oxide of iron,	4.00
Silex,	2.00
Water,	20.00
	102.73

Organic matter, . . . an undetermined quantity.

As this analysis did not agree with the composition stated by M. Bachelier, the son, and as it was possible, that in scraping off the badigeon, some of the substance of the pillars (to which it was attached) might have been taken along with it, which would have changed the result that ought to be obtained, M. Guyton collected some badigeon, with which paper was covered, and he found that this, in a dry state, after calcination in a crucible, where it lost 0.18 of its weight, was composed of

Quick lime,	56.66
Baked plaster, (gypsum,)	23.34
Ceruse, or carbonate of lead,	20.00
	100.00

After the great number of researches made on the badigeon of Bachelier, the commissioners named by the Institute to examine it, thus directed the composition, which had succeeded best with them. Slake the lime with the smallest quantity of water possible; pound it along with white cheese, to the consistence of a soft, uniform, and

well-united paste; add to it, baked plaster (gypsum), and ceruse; and by a more exact grinding with water, reduce the whole to the thickness of soup, rather more thick, than thinner; finally, dilute it with common water, at the moment of laying it on, which is usually performed with a varnisher's brush.

It may be perceived, after all the foregoing details, how much there still remains to be done, to obtain exact facts relative to lime stones, their calcination, the goodness and applications of the different species of limes, and, finally, with respect to the composition of mortars, betons, cements, stuccos, and badigeons. We shall find ourselves well rewarded, if this work should excite architects, and men of science, to occupy themselves with these objects, and if their researches should successfully lead them to useful discoveries.

ENGLISH PATENTS.

Specification of the Patent granted to JEAN LE GRAND, *of Lemon street, Goodman's-fields, Middlesex, Vinegar manufacturer, for certain improvements in fermented liquors and the various products to be obtained therefrom. Partly communicated by a foreigner.* Dated January 15, 1824.

THE said improvements in the said fermented liquors, and the various products to be obtained therefrom, are as follows. In order to give those wines, and vinegars, which are not obtained from grapes, the qualities which distinguish those made from grapes, I employ the following substances; namely, the tartaric, citric, and oxalic acids, and which I add, either separately, or together, and either in the crystallized state, or diluted with water, to all kinds of fermented worts, wash, or liquors; and either before, during, or after the vinous or acetous fermentations, I likewise mix the said vegetable acids, either singly or together, with all sorts of spirituous liquors, either pure, or diluted with water, or other liquids, with the design of converting those spirits, by acidification, into vinegar, similar to that made from the wine of grapes; or, by distillation or rectification, to convert them into brandy, analogous to that obtained from grapes. I likewise employ the same vegetable acids, by mixing one or more of them with acetic acid, or any kind of vinegar, to increase the strength of those liquids, or to impart to them the qualities of the vinegars obtained from grapes or other fruit.

In witness whereof, &c. [*Rep. Pat. Inventions.*

Patent granted to JOHN PARKER, *of Knightsbridge, Middlesex, Iron and Wire Fence Manufacturer, for improvements, or additions, to park, or other gates.* Dated May 23, 1826.

THE object of Mr. Parker's "additions" to gates, is to cause them to open on the approach of a carriage, and to close again as soon as

it has passed, without any person being required to assist, directly, in the operation.

The power that produces this effect, is the weight of the carriage, which is made to operate by pressing down, on its passage, an inclined plane, beneath which a bent lever, or crank is placed in a vertical position, on whose inclined arm, an upright piece, connected with the inclined plane, is supported; while the top of its vertical arm is connected by a long bar, with the circumference of a horizontal wheel placed near the gate, the farther side of which, being toothed, turns a horizontal pinion, that is fastened to the bottom of the pivot on which the gate revolves; on the side of the crank next the gate, there is a third arm, in a horizontal position, to the end of which a weight is attached, sufficiently heavy to push the long bar back against the wheel, in the contrary direction to that mentioned, and thereby to shut the gate, after the carriage has passed.

This is the outline of the contrivance, but to carry it into effect, it is also necessary that the gate should be kept open for a certain time, after it is thrown back by the machinery mentioned; that previous to this, it should be freed from the catch which holds it to the gate-post; and lastly, that the parts which hold it open should be removed as soon as the carriage passes, so as to permit the counter-weight to operate in closing the gate again, as at first.

These secondary operations are performed by apparatus of the same kind as that mentioned. Of which that, which raises the catch on the gate-post from the latch, is at the opposite side of the way from the machinery that opens and shuts the gate; while that, which keeps it open and removes the impediments to its being closed, is at the same side. The whole of the parts, that communicate the motion from the moveable inclined planes, to the gate and catches, are placed in long cases or troughs under ground, so that nothing appears above the surface but the inclined planes, the ledges or guides, which confine the wheels of the carriage to the tracks, in which they must encounter these inclined planes, and the thick wires which work the catches.

To hold the gate open, when it is thrown back by the means before explained, there are posts placed at each side of it, in a line with the hinge post, at the same distance from the latter, as the main catch-post; and to each of these posts, catches are attached, of the same nature as the main-catch on the gate post, which catches lay hold of the latch of the gate, and retain it until the wheel of the carriage passes over the inclined plane that works the cranks, which draw down the wires that act on one side of the catches, and elevate them on the other, by turning them round upwards on the hinges that attach them to the posts, out of the way of the latch, (which is of the upright spring kind,) immediately after which, the counterweight operates in closing the gate, and pressing the latch into the main catch on the gate post; which catch, is raised from it, in a similar manner to that described, by inclined planes at the other side of the way, on which the wheel of the carriage acts, a little before it arrives at the principal inclined plane, which opens and shuts the gate.

The cranks by which the catches are moved, have counter-weights to them, as well as those which turn the gate, to bring them to their first positions, and to raise the inclined planes connected with them, so as to be operated on by the pressure of the carriage wheels in passing over them. The gate opens at both sides; and as the apparatus must operate, whichever way the carriage approaches to the gate, in order to be complete, all the parts described are double; or, in other words, a similar apparatus is placed at each side of the gate both for opening and shutting it, and for holding it open and lifting the catches; the inclined planes of which are at sufficient distances from the gate at each side, to allow ample space for the horses in front, so that they shall be entirely out of the way of the movements of the gate.

Lastly, it is mentioned in the specification, that a small vertical roller is placed beneath the rim of the horizontal wheel that acts on the pinion on the pivot of the gate, in order to support it better there against the weight of the ends of the long horizontal bars that connect it with the inclined planes, and thereby enable it to be turned round with more facility. [*ib.*

To EDMUND LLOYD, *of North End, Fulham, in the County of Middlesex, Gentleman, for his Invention of a new apparatus, from which he purposes to feed Fires with coal and other fuel.*

THIS apparatus may be adapted to almost every kind of fire place; it consists of a box or recess, formed behind the grate, a little above the top of the fire, which box or recess is to receive a sufficient quantity of coal or other fuel, to supply the consumption of the fire for a considerable time. The box is to be closed in front by a sliding door, supported by chains passed over pullies, which door being balanced may be readily slidden up, by applying the hand to a small nob, or button, and when the door has been thus raised, the coal may be drawn forward on to the fire.

The weight of the door is proposed to be counterpoised by a loggerhead, or iron ball attached to the end of a lever above, which in its descent draws up the suspending chains, and thereby raises the door with very little labour.

The apparatus may be slightly varied in several ways, still adhering to the principle, which is so simple and obvious, that a representation of the contrivance is not necessary, and indeed its plan of arrangement would require some degree of variation under every change of situation, or circumstance.—Enrolled April, 1825.

[*Newton's Journal.*

To JOHN PHIPPS *of Upper Thames Street, in the City of London, Stationer, and* CHRISTOPHER PHIPPS, *of the Parish of River, in the County of Kent, Paper-maker, for their Invention of an Improvement or Improvements in Machines for Making Paper.*

THIS improvement applies to a certain apparatus, which has been many years in use, denominated "Fourdrinier's patent machine for making paper, of an infinite, or any required length." This machine is so constructed, that the pulp, of which the paper is to be made, flows freely from the vat, on to an endless web of wire-gause, and being there agitated, is caused to settle into a compact consistency. The paper thus made, is then progressively carried forward, by the traversing of the endless web, and passed between squeezing rollers, for the purpose of expressing the water, and is thence conducted, by an endless felt, to the reel, where it is taken up as fast as it becomes formed upon the gause web.

This machine has been heretofore capable of producing only that description of paper, called wove, that is, without lines or water marks: it is therefore the object of the patentees, by their present improvement, to enable the same machine to make what is called laid paper, that is, with lines or water marks.

In order to effect this, they propose to construct a cylinder, the periphery of which shall be made of wire-gause, or the same material that flat paper moulds are usually made of. This cylinder is to be formed by wooden ends, and a series of concentric rings or hoops, having an iron axle through the whole, and the wire-gause to be bound round the periphery of the cylinder, and so neatly joined at the seam, that no junction shall be perceptible. This cylinder is then to be mounted upon the machine, by its pivots falling loosely into slots, or openings, in brass carriages, placed on the side frames of the machine, and the cylinder bearing with considerable weight upon the new formed paper lying upon the endless web, (as described above,) will, by the traversing of the paper, and the web under it, be made to revolve, and the wires upon the periphery of the cylinder, to impress the required lines or water marks into the new formed paper.—Enrolled July, 1825. [*ib.*

To BENJAMIN FARROW, *of Great Tower Street, in the City of London, Ironmonger, for his Invention of an Improvement, or Improvements in Buildings, calculated to render them less likely to be Destroyed or Injured by Fire, than heretofore, which he conceives will be of public utility.*

THIS improvement consists in the employment of wrought iron joists, for supporting the floors and ceilings of houses, instead of wood, as usual, and which joists, by their peculiar form, afford the

means of filling up the interstices between them, with bricks, stones, or other incombustible substances, so as to render the partitions between each floor, perfectly fire-proof.

The joists are each to be made of two flat bars of iron; the edge of one, is to be fastened by means of screws, or rivets, to the middle of the flat side of the other, so that its section will appear in this form. ⊥ The ends of the lower bar, are to be turned down, in order to fix it the more securely into the wall.

When the joists have been thus laid at suitable distances apart, and firmly fixed into the walls of the building, the stone slabs, bricks, tiles, or other materials, of which the floor is to be formed, are placed upon the ledges or rebates of the joists, and are then fastened together with mortar, or Roman cement, which forms a perfectly incombustible partition, between the upper, and lower story.

This contrivance, is designed to supersede the necessity of arching the rafters, which is sometimes practised in constructing fire proof buildings. The stones being made rough on the under side, by pecking, are fit to receive the plaster for ceiling the lower apartment, and the wooden flooring is laid down, on the upper side, by screws passed through the wood into the iron.

Roofs of buildings may be constructed in the same way, by laying the rafters upon a slight inclination, for the purpose of allowing rain water to run off into the gutters.

The rafters have been described as made of two bars of wrought iron, screwed or pinned together, but when employed for small houses, they may be made in one piece, by rolling, in the way bars and rods of iron are commonly formed at the iron works.—Enrolled August, 1825. [*Rep. Pat. Inventions.*

Patent granted to William Hirst, *of Leeds, County of York, Cloth Manufacturer, for improvements in spinning, and stubbing machines.* Dated Jan. 11, 1825.

Mr. Hirst's improvements, (which, though intended for machines for spinning wool, may be extended to those for cotton, and other fibrous substances,) consist in having a double number of spindles in each machine, by placing a second row behind the first, so that each spindle in it shall be opposite to the interval between two of those in the first row, and by making the following alterations in and additions to some other parts of the machines, which this change renders necessary. First, as the number of threads is twice as great as before, the number of robings must be increased in the same proportion, which is effected by adding two more "creels," or rows of robings, one above and the other below the two rows of the original machine. Secondly, the fluted rollers, which in the common machines are divided into separate bosses for each thread, with vacant spaces between them, are in Mr. Hirst's machines made continuous without any separations; to enable them to act on the double number of threads, which are to pass over them. And, lastly, the additional

bands necessary for the increased number of spindles, are made to fall in on the vertical drums by which they are turned in the machines, by fixing on them the "warls," or whirls, of the new spindles at elevations different from those of the primary row, so that the bands may move in separate horizontal planes, in such a manner as to avoid all contact and interference with each other.

These improvements of Mr. Hirst's are of that simple species, the advantage of which is so very apparent, as to create some degree of surprise, that they have not been before adopted. They appear to us to be particularly beneficial, in such places where rents of buildings are high, as they cause the new machines to do twice the quantity of work, without occupying any more space than the old machines; and, moreover, have the farther advantage of requiring no additional expense in mill machinery, framing, or the wheel work of the separate machines, than is necessary for the original machines, which only performed half the work.

It seems probable, that the principle adopted on this occasion may be farther extended, by using three or more rows of spindles, in such machines, in place of the original single row; the only limits to this plan appearing to be the number of threads, that can be made to lie on the fluted rollers, without becoming entangled by their projecting fibres. It is true that even these limits seem capable of being enlarged, by having a second row of fluted rollers; but we doubt very much whether the difficulty of piecing the broken threads, and the other embarrassments, which the crowded state of the work, caused by this latter arrangement, might occasion, would not more than counterbalance any benefit, that might be obtained by its adoption.

[*ib.*

The Marquis of Worcester, and the 'CENTURY OF INVENTIONS.'

It has been suggested to us, that a republication of the Marquis of Worcester's Century of Inventions, would be generally acceptable. With a view to comply with this suggestion, we applied for the copy of the work in the Philadelphia Library, and were gratified by finding one of the first impressions of the book, published in the year 1663.

The first edition of the "Century," is very rare, and it may well be so, if the account given by Desaguliers be correct. He states that captain Savary, to conceal the fact of his having derived from this book, the information which led to the construction of his steam engine, purchased up all the copies he could find, and burned them.

The circumstance which has given to this work its greatest celebrity, is the generally acknowledged fact, that it contains, in article 68, the first account of the application of steam, to the raising of water in large quantity, and to a considerable height. Some, it is true, have attempted to deprive the author of this honour, and have cited the contrivances of De Caus, Branca, and some others; these, however, were but ingenious toys, and will scarcely be admitted to interfere with the claims of the marquis of Worcester.

Some of the projects, mentioned in the "Century," are altogether absurd, being contrary to the established laws of nature; it must be recollected, however, that the work before us, was not designed to satisfy inquiry, but to excite surprise, and that the whole is therefore written in a style of mystery and enigma: several of the propositions which were formerly deemed impracticable, no longer stand in this predicament, as they have been carried into effect, in a way which fully justifies the account given by the marquis, and in the whole number, there are but few which a competent judge would pronounce to be impossible.

The editor of the London Mechanics' Magazine, compared a good printed copy of the "Century" with a MS. in the hand writing of the marquis himself, which is preserved in the British museum; and has, in his republication of it, given the variations in this MS. in the foot notes. They are in general immaterial; in one instance, however, the MS. has substituted quite a different invention, for that in the printed copy: this is in No. 88.

The following account of the marquis, together with the variations above noticed, we copy from the Mechanics' Magazine; and shall add, from the same source, a very interesting article, intended to prove that the marquis actually constructed and applied the steam engine to practical purposes. EDITOR.

The author of this singular production, of whom our readers may not be displeased to know, previously, some particulars, was one of the most remarkable political characters of his age. He was "the famous earl of Glamorgan, so created by Charles the First while heir-apparent to the marquis of Worcester. He was a bigoted Catholic, but in times when that was no disrecommendation, and when it grew a merit. Being of a nature extremely enterprising, and a warm loyalist, he was despatched into Ireland by the king. Here history lays its finger, at least is interrupted by controversy. The censurers of king Charles charge that prince with sending this lord to negotiate with the Irish rebel Catholics, and to bring over a great body of them for the king's service. The devotees of Charles would disculpate him, and accuse the lord Glamorgan of forging powers from the king for that purpose. The fact stands thus: the treaty was discovered, the earl was imprisoned by the king's servants in Ireland, and was dismissed by them, unpunished, before the king's pleasure was known. The parliament complained; the king disavowed the earl, yet renewed his confidence in him; nor did the earl ever seem to resent the king's disavowal, which, with much good nature, he imputed to the necessities of his majesty's affairs."*

The king, "with all his affection for the earl, in one or two letters to others, mentions his want of judgment. Perhaps his majesty was glad to trust to his indiscretion. With *that* his lordship seems [to have been] greatly furnished. We find him taking oaths upon oaths to the pope's nuncio, with promises of unlimited obedience both to

* Walpole's Royal and Noble Authors.

his holiness and to his delegate, and begging five hundred pounds of the Irish clergy, to enable him to embark and fetch fifty thousand pounds—like an alchemist, who demands a trifle of money, for the secret of making gold. In another letter he promises two hundred thousand crowns, ten thousand arms for foot, two thousand cases of pistols, eight hundred barrels of powder, and thirty or forty well provided ships!! when he had not a groat in his purse, or as much gunpowder as would scare a corbie! It is certain that he and his father wasted an immense sum in the king's cause; of all which merits and zeal his majesty was so sensible, that he gave the earl the most extraordinary patent, perhaps, that ever was granted; the chief powers of which were to make him generalissimo of three armies, and admiral, with nomination of his officers, to enable him to raise money by selling his majesty's woods, wardships, customs and prerogatives, and to create, by blank patents, to be filled up at Glamorgan's pleasure, from the rank of baronet to that of marquis. If any thing could justify the delegation of such authority, besides his majesty having lost all authority when he conferred it, it was the promise with which the king concluded, of bestowing the princess Elizabeth on Glamorgan's son. It was time to adopt into his family, when he had into his sovereignty. This patent, the marquis, after the restoration, gave up to the house of peers. He did not long survive that era, dying in 1667."*

The marquis's Century of Inventions, which we are now to lay before our readers, was first printed in 12mo., in 1683.† Walpole is pleased to designate it as an "amazing piece of folly;" but later and better informed writers have been led to think differently of it. Granger remarks—"That a practical mathematician, who has quickness to seize a hint and sagacity to apply it, might avail himself greatly of these scantlings, though little more than a bare catalogue." And the same writer was informed by the late reverend and ingenious mechanic, Mr. Gainsborough, of Henley, brother to the celebrated painter, that the marquis's work was far from being such a collection of whims and chimeras as it has been supposed to be, and that, on the contrary, "he highly esteemed the author as one of the greatest mechanical geniuses that ever appeared in the world." It is quite certain, too, that since his time several of his "inventions" or suggestions have been reduced to practice; and hence the whole have become entitled to be treated with more respect. Professor Robison goes so far even as to affirm, that the steam-engine, the greatest discovery of modern times, "was, beyond all doubt, invented by the marquis;" and though later researches have shown that this is somewhat unmerited praise, it is evident that he entertained views of the applicability of steam as a moving power, such as no other individual of the age in which he lived had the sagacity to embrace.

The "book" which he promises, at the conclusion of the century, to leave to posterity, showing "the means to put in execution and visible trial, all, and every of these inventions, with the shape and

* Walpole.

† This is a mistake, the copy before us is in 24mo., and dated in 1663.
[*Editor Franklin Journal.*

form of all things belonging to them,—printed by brass plates," he did not live to execute.

A CENTURY OF THE NAMES AND SCANTLINGS OF SUCH INVENTIONS AS AT PRESENT I CAN CALL TO MIND TO HAVE TRIED AND PERFECTED, WHICH (MY FORMER NOTES BEING LOST) I HAVE, AT THE INSTANCE OF A POWERFUL FRIEND, ENDEAVOURED NOW, IN THE YEAR 1655, TO SET THESE DOWN IN SUCH A WAY AS MAY SUFFICIENTLY INSTRUCT ME TO PUT ANY OF THEM IN PRACTICE.

"Artis, et Naturæ proles."

LONDON, printed by *J. Grismond*, in the year 1663.

To the King's Most Excellent Majesty.

SIR—"*Scire meum nihil est, nisi me scire hoc sciat alter*," saith the poet, and I must justly, in order to your majesty, whose satisfaction is my happiness, and whom to serve is my only aim, placing therein my *summum bonum* in this world: be, therefore, pleased to cast your gracious eye over this summary collection, and then to pick and choose. I confess I made it but for the superficial satisfaction of a friend's curiosity, according as it is set down; and if it might now serve to give aim to your majesty how to make use of my poor endeavours, it would crown my thoughts, who am neither covetous nor ambitious but of deserving your majesty's favour, upon my own cost and charges; yet, according to the old English proverb, *It is a poor dog not worth whistling after.* Let but your majesty approve, and I will effectually perform to the height of my undertaking: vouchsafe but to command, and with my life and fortune I shall cheerfully obey, and, *maugre* envy, ignorance, and malice, ever appear your majesty's passionately devoted, or, otherwise, disinterested subject and servant,

WORCESTER.

To the right honourable the lords spiritual and temporal, and to the knights, citizens, and burgesses of the honourable house of commons, now assembled in parliament.

My lords and gentlemen—Be not startled if I address to all, and every of you, this century of summary heads of wonderful things, even after the dedication of them to his most excellent majesty, since it is with his most gracious and particular consent, as well as indeed no ways derogating from my duty to his sacred self, but rather in further order unto it, since your lordships, who are his great council, and you, gentlemen, his whole kingdom's representatives (most worthily welcome unto him,) may fitly receive into your wise and serious considerations what doth or may publicly concern both his majesty and his tenderly beloved people.

Pardon me if I say (my lords and gentlemen) that it is jointly your parts to digest, to his hand, these ensuing particulars, fitting

them to his palate, and ordering how to reduce them into practice in a way useful and beneficial both to his majesty and his kingdom.

Neither do I esteem it less proper for me to present them to you, in order to his majesty's service, than it is to give into the hands of a faithful and provident steward whatsoever dainties and provisions are intended for the master's diet; the knowing and faithful steward being best able to make use thereof to his master's contentment and greatest profit, keeping for the morrow whatever should be overplus or needless for the present day, or, at least, to save something else in lieu thereof. In a word, (my lords and gentlemen,) I humbly conceive this simile not improper, since you are his majesty's provident stewards, into whose hands I commit myself with all properties fit to obey you, that is to say, with a heart harbouring no ambition, but an endless aim to serve my king and country; and if my endeavours prove effectual, (as I am confident they will,) his majesty shall not only become rich, but his people likewise as treasurers unto him; and his peerless majesty, our king, shall become both beloved at home and feared abroad, deeming the riches of a king to consist in the plenty enjoyed by his people.

And the way to render him to be feared abroad is, to content his people at home, who then, with heart and hand, are ready to assist him; and whatsoever God blesseth me with to contribute towards the increase of his revenues in any considerable way, I desire it may be employed to the use of his people; that is, for the taking off such taxes or burthens from them as they chiefly groan under, and by a temporary necessity only imposed upon them, which, being thus supplied, will certainly best content the king and satisfy his people, which, I dare say, is the continual tend of all your indefatigable pains, and the perfect demonstrations of your zeal to his majesty, and an evidence that the kingdom's trust is justly and deservedly reposed in you. And if ever parliament acquitted themselves thereof, it is this of yours, composed of most deserving and qualified persons—qualified, I say, with your affection to your prince, and with a tenderness to his people; with a bountiful heart towards him, yet a frugality in their behalf.

Go on, therefore, cheerfully (my lords and gentlemen,) and not only our gracious king, but the King of kings, will reward you; the prayers of the people will attend you; and his majesty will, with thankful arms, embrace you. And be pleased to make use of me and my endeavours to enrich them, not myself. Such being my only request unto you, spare me not in what your wisdom shall find me useful, who do esteem myself, not only by the act of the water-commanding engine (which so cheerfully you have past,) sufficiently rewarded, but likewise with courage enabled to do ten times more for the future; and my debts being paid, and a competency to live according to my birth and quality settled, the rest shall I dedicate to the service of our king and country by your disposals; and esteem me not the more, or, rather, any more, by what is past, but what is to come; professing really, from my heart, that my intentions are to outgo the six or seven hundred thousand pounds already sacrificed, if

countenanced and encouraged by you, ingenuously confessing that the melancholy which hath lately seized upon me (the cause whereof none of you but may easily guess) hath, I dare say, retarded more advantages to the public service than modesty will permit me to utter; and now, revived by your promising favours, I shall infallibly be enabled thereunto in the experiments extant and comprised under these heads, practicable with my directions by the unparallelled workman, both for trust and skill, *Caspar Kaltoff's* hand, who hath been these five and thirty years as in a school, under me employed, and still at my disposal, in a place by my great expenses made fit for public service, yet lately like to be taken from me, and consequently from the service of king and kingdom, without the least regard of about ten thousand pounds expended by me, and through my zeal, to the common good; my zeal, I say, a field large enough for you (my lords and gentlemen) to work upon.

The treasures buried under these heads, both for war, peace and pleasure, being inexhaustible, I beseech you pardon me if I say so. It seems a vanity, but it comprehends a truth, since no good spring but becomes the more plentiful by how much more it is drawn, and the spinner to weave his web is never stinted but further inforced.

The more then that you shall be pleased to make use of my inventions, the more inventive shall you ever find me; one invention begetting still another, and more and more improving my ability to serve my king and you; and as to my heartiness therein, there needs no addition, nor to my readiness a spur. And therefore (my lords and gentlemen) be pleased to begin, and desist not from commanding me till I flag in my obedience and endeavours to serve my king and country:

> For certainly you'll find me breathless first t'expire,
> Before my hands grow weary, or my legs do tire.

Yet, abstracting from any interest of my own, but as a fellow-subject and compatriot, will I ever labour in the vineyard, most heartily and readily obeying the least summons from you, by putting faithfully in execution, what your judgments shall think fit to pitch upon, amongst this century of experiences, perhaps dearly purchased by me, but now frankly, and *gratis*, offered to you. Since my heart (methinks) cannot be satisfied in serving my king and country, if it should cost them any thing, as I confess, when I had the honour to be near so obliging a master, as his late majesty, of happy memory, who never refused me his ear to any reasonable motion; and as for unreasonable ones, or such as were not fitting for him to grant, I would rather to have died a thousand deaths, than ever to have made any one unto him.

Yet, whatever I was so happy as to obtain for any deserving person, my pains, breath, and interest, employed therein, satisfied me not, unless I likewise satisfied the fees; but that was in my golden age. And even now, though my ability and means are shortened, (the world knows why,) my heart remains still the same; and be you pleased, my lords and gentlemen, to rest most assured, that the very

complacency that I shall take in the executing your commands, shall be unto me a sufficient and an abundantly satisfactory reward.

Vouchsafe, therefore, to dispose freely of me, and whatever lieth in my power to perform—first, in order to his majesty's service; secondly, for the good and advantage of the kingdom; thirdly, to all your satisfactions, for particular profit and pleasure to your individual selves: professing that, in all and each of the three respects, I will ever demean myself as it best becomes, my lords and gentlemen, your most passionately bent fellow-subject in his majesty's service, compatriot for the public good and advantage, and a most humble servant to all and every of you, WORCESTER.

A Century of the names and scantlings of Inventions by me already practised.

1. Several sorts of seals, some showing by screws, others by gages fastening or unfastening all the marks at once, others by additional points and imaginary places, proportionable to ordinary escutcheons and seals at arms, each way palpably and punctually setting down (yet private from all others, but the owner, and by his assent,) the day of the month, the day of the week, the month of the year, the year of our Lord, the names of the witnesses, and the individual place where any thing was sealed, though in ten thousand several places, together with the very number of lines contained in a contract, whereby falsification may be discovered, and manifestly proved, being upon good grounds suspected.

Upon any of these seals, a man may keep accounts of receipts and disbursements, from one farthing to a hundred millions, punctually showing each pound, shilling, penny, or farthing.

By these seals, likewise, any letter, though written but in English, may be read and understood in eight several languages, and in English itself to clean contrary and different sense, unknown to any but the correspondent, and not to be read or understood by him neither, if opened before it arrive unto him; so that neither threats, nor hopes of reward, can make him reveal the secret, the letter having been intercepted, and first opened by the enemy.

2. How ten thousand persons may use these seals to all and every of the purposes aforesaid, and yet keep their secrets from any but whom they please.

3. A cipher and character, so contrived, that one line, without returns and circumflexes, stands for each and every of the twenty-four letters, and as ready to be made for the one letter as the other.

4. This invention, refined, and so abbreviated, that a point only showeth distinctly and significantly any of the twenty-four letters, and these very points to be made with two pens; so that no time will be lost, but as one finger riseth, the other may make the following letter, never clogging the memory with several figures, for words and combinations of letters, which, with ease, and void of confusion, are thus speedily and punctually, letter for letter, set down by naked, and not multiplied points. And nothing can be less than a point, the

mathematical definition of it, being *cujus pars nulla.* And of a motion, no swifter imaginable, than semiquavers, or releshes; yet applicable to this manner of writing.

5. A way, by a circular motion, either along a rule, or ringwise, to vary any alphabet, even this of points, so that the self-same point, individually placed, without the least additional mark, or variation of place, shall stand for all the twenty-four letters, and not for the same letter twice in ten sheets' writing; yet, as easily and certainly read and known, as if it stood but for one and the self-same letter, constantly signified.

6. How, at a window, as far as eye can discover black from white, a man may hold discourse with his correspondent, without noise made, or notice taken; being, according to occasion given, and means afforded, *ex re nata*, and no need of provision beforehand; though much better if foreseen, and means prepared for it, and a premeditated course taken, by mutual consent of parties.

7. A way to do it by night, as well as by day, though as dark as pitch is black.

8. A way how to level and shoot cannon, by night, as well as by day, and as directly, without a platform, or measures taken by day, yet by a plain and infallible rule.

9. An engine, portable in one's pocket, which may be carried and fastened on the inside of the greatest ship, *tanquam aliud agens*, and, at any appointed minute, though a week after, either of day or night, it shall irrecoverably sink that ship.

10. A way, from a mile off, to dive, and fasten a like engine to any ship, so as it may punctually work the same effect, either for time or execution.

11. How to prevent and safeguard any ship from such an attempt, by day or night.

12. A way to make a ship not possible to be sunk, though shot a hundred times betwixt wind and water, by cannon, and should lose a whole plank; yet, in half an hour's time, should be made as fit to sail as before.

13. How to make such false decks as, in a moment, should kill, and take prisoners, as many as should board the ship, without blowing the decks up, or destroying them, from being reducible; and, in a quarter of an hour's time, should recover their former shape, and to be made fit for any employment, without discovering the secret.

14. How to bring a force, to weigh up an anchor, or to do any forcible exploit, in the narrowest or lowest room in any ship, where few hands shall do the work of many; and many hands applicable to the same force, some standing, others sitting, and, by virtue of their several helps, a great force augmented in little room, as effectual as if there were sufficient space to go about with an axletree, and work far from the centre.

15. A way how to make a boat work itself against wind and tide, yea, both, without the help of man or beast; yet so that the wind, or tide, though directly opposite, shall force the ship, or boat, against itself, and in no point of the compass, but it shall be as effectual as if the

wind were in the *poop*, or the stream actually with the course it is to steer, according to which the oars shall row, and necessary motions work and move, towards the desired port, or point of the compass.

16. How to make a sea-castle, or fortification, cannon-proof, and capable of containing a thousand men; yet sailable at pleasure to defend a passage; or, in an hour's time, to divide itself into three ships, as fit and trimmed to sail as before; and even whilst it is a fort, or castle, they shall be unanimously steered, and effectually be driven, by an indifferent strong wind.

17. How to make upon the Thames, a floating garden of pleasure, with trees, flowers, banqueting-houses, and fountains, stews for all kinds of fishes, a reserve for snow, to keep wine in, delicate bathing-places, and the like; with music, made with* mills, and all in the midst of the stream, where it is most rapid.

18. An artificial fountain, to be turned, like an hour-glass, by a child, in the twinkling of an eye; it holding a great quantity of water, and of force sufficient to make snow, ice, and thunder; with a chirping and singing of birds, and showing of several shapes and effects, usual to fountains of pleasure.

19. A little engine, within a coach, whereby a child may stop it, and secure all persons within it, and the coachman himself, though the horses be never so unruly in a full career; a child being sufficiently capable to loosen them, in what posture soever they should have put themselves, turning never so short, for a child can do it in the twinkling of an eye.

20. How to bring up water, balancewise, so that as little weight, or force, as will turn a balance, will be only needful, more than the weight of the water within the buckets, which, counterpoised, empty† themselves, one into the other, the uppermost yielding its water (how great a quantity soever it holds) at the self-same time the lowermost taketh it in, though it be a hundred fathom high.

21. How to raise water constantly with two buckets only, day and night, without any other force than its own motion, using not so much as any force, wheel, or sucker, nor more pulleys than one, on which the cord, or chain, rolleth, with a bucket fastened at each end. This, I confess, I have seen and learned of the great mathematician, Claudius,‡ his Studies at Rome, he having made a present thereof unto a cardinal; and I desire not to own any other men's inventions, but if I set down any, to nominate likewise the inventor.

22. To make a river in a garden to ebb and flow constantly, though twenty feet over, with a child's force, in some private room, or place, out of sight, and a competent distance from it.

23. To set a clock in‖ a castle, the water filling the trenches about it; it shall show, by ebbing and flowing, the hours, minutes, and seconds, and all the comprehensible motions of the heavens, and counterlibration of the earth, according to Copernicus.

* "By," MS. copy.
† "Clavius."
† "Counterpoised and empty."
‖ "As within."

24. How to increase the strength of a spring to such a height, as to shoot bumbasses and bullets of a hundred pounds weight, a steeple height, and a quarter of a mile off, and more, stone-bowwise; admirable for fire-works, and astonishing of besieged cities, when, without warning given by noise, they find themselves so forcibly and dangerously surprised.

25. How to make a weight that cannot take up a hundred pounds, and yet shall take up two hundred pounds, and at the self-same distance from the centre; and so, proportionably, to millions of pounds.

26. To raise weight as well and as forcibly with the drawing back of the lever, as with the thrusting it forwards; and, by that means, to lose no time, in motion, or strength. This I saw in the arsenal at Venice.

27. A way to move to and fro, huge weights, with a most inconsiderable strength, from place to place. For example, ten ton with ten pounds, and less; the said ten pounds not to fall lower than it makes the ten ton to advance, or retreat, upon a level.

28. A bridge, portable in* a cart, with six horses, which, in a few hours' time, may be placed over a river half a mile broad, whereon, with much expedition, may be transported horse, foot, and cannon.

29. A portable fortification, able to contain five hundred fighting men; and yet, in six hours time, may be set up, and made cannon-proof, upon the side of a river, or pass, with cannon mounted upon it, and as complete as a regular fortification, with half-moons and counterscarps.

30. A way, in one night's time, to raise a bulwark, twenty or thirty feet high, cannon-proof, and cannon mounted upon it, with men to overlook, command, and batter a town; for though it contain but four pieces, they shall be able to discharge two hundred bullets each hour.

31. A way how, safely and speedily, to make an approach to a castle, or town wall, and over the very ditch, at noon-day.

32. How to compose a universal character, methodical, and easy to be written, yet intelligible in any language; so that, if an Englishman write it in English, a Frenchman, Italian, Spaniard, Irish, Welch, being scholars, yea, Grecian, or Hebritian, shall as perfectly understand it in their own tongue, as if they were perfect English, distinguishing the verbs from nouns, the numbers, tenses, and cases, as properly expressed in their own language as it was written in English.

33. To write with a needle and thread, white, or any colour, upon white, or any other colour, so that one stitch shall significantly show any letter, and as readily and as easily show the one letter as the other, and fit for any language.

34. To write by a knotted silk string, so that every knot shall signify any letter, with comma, full point, or interrogation, and as legible as with pen and ink upon white paper.

35. The like, by the fringe of gloves.

* "Upon."

36. By stringing of bracelets.
37. By pink'd gloves.
38. By holes in the bottom of a sieve.
39. By a lattin, or plate lanthorn.*
40. By the smell.
41. By the taste.
42. By the touch.

By these three senses, as perfectly, distinctly, and unconfusedly, yea, as readily, as by the sight.

43. How to vary each of these, so that ten thousand may know them, and yet keep the understanding part from any but their correspondent.

44. To make a key of a chamber-door, which, to your sight, hath its wards and rosepipe but paper thick, and yet, at pleasure, in a minute of an hour, shall become a perfect pistol, capable to shoot through a breast-plate commonly of carabine-proof, with prime, powder, and fire-lock, undiscoverable in a stranger's hand.

45. How to light a fire and candle, at what hour in the night one waketh, without rising, or putting one's hand out of the bed. And the same thing becomest a serviceable pistol, at pleasure; yet, by a stranger, not knowing the secret, seemeth but a dexterous tinder-box.

46. How to make an artificial bird, to fly which way, and as long, as one pleaseth, by or against the wind, sometimes chirping, other times hovering, still tending the way it is designed for.

47. To make a ball of any metal, which, thrown into a pool or pail of water, shall presently rise from the bottom, and constantly show, by the superficies of the water, the hour of the day, or night, never rising more out of the water than just to the minute it showeth of each quarter of the hour; and if by force kept under water, yet the time is not lost, but recovered, as soon as it is permitted to rise to the superficies of the water.

48. A screwed ascent, instead of stairs, with fit landing-places to the best chambers of each story, with back stairs within the newel of it, convenient for servants to pass up and down to the inward rooms of them, unseen and private.

49. A portable engine, in the way of a tobacco tongs, whereby a man may get over a wall, or get up again, being come down, finding the coast proving insecure to him.

50. A complete, light, portable ladder, which, taken out of one's pocket, may be, by himself, fastened a hundred feet high, to get up by, from the ground.

(TO BE CONTINUED.)

* "Candlestick lanthorn." † "To be."

Experiments on the Action of Water upon Glass, with some Observations on its slow Decomposition. By Mr. T. GRIFFITHS, *Chemical Assistant in the Laboratory of the Royal Institution.*

IT is a commonly received notion, that glass is capable of resisting, to a very great extent, the attacks of active chemical solvents, and that its alkali can neither be readily separated, nor exhibited, in an insulated form, without regularly submitting it to powerful decomposing agents. Speaking of glass, in common language, without any reference to the many soluble compounds so designated, it may be a new fact in chemistry, to prove that this singular substance possesses highly alkaline properties, which may easily be shown by the usual tests.

Upon reducing some thick flint-glass to a moderately fine powder in an earthenware mortar, for the purpose of analysis, a portion of it was placed on turmeric paper, with a view of determining if it possessed any sensible alkaline property; and, upon being moistened with water, the yellow colour of the test-paper was instantly reddened, nearly as powerfully as if lime had been employed. This effect was considered as accidental, and as probably arising from some adventitious alkaline matter, or soap, adhering to the vessels employed. Another experiment was made, with greater care, in an agate-mortar, but with the same, or even a more decided result, in consequence of the more minute division of the material. When pulverized on perfectly clear, and polished surfaces of iron, steel, zinc, copper, silver and platinum, the effect took place, and apparently, with great facility; but it was found that the presence of small quantities of oxide of iron, greatly diminished it; in consequence, as was afterwards proved, of the particles of glass being by them defended from the contact of water.

Since there are some saline bodies, and metallic combinations, which give indications of alkali to turmeric paper, although perfectly neutral compounds, and as pure magnesia reddens this paper when moistened with water, although no solution can be shown to take place, possibly this might be an effect of the kind, it scarcely appearing probable that any soluble matter should be abstracted from the powdered glass by the mere effusion of pure water. Litmus paper, therefore, reddened by an acid, and paper stained with the blue infusion of cabbage, were also employed as tests; the former had its blue colour restored, and the latter was rendered green.

A portion of flint-glass, in fine powder, was boiled in water for some hours; upon being allowed to cool and subside, the clear portion was decanted and evaporated, and became strongly alkaline to the taste, and to other usual tests; a drop of its concentrated solution, gradually evaporated on a glass-plate, on exposure to the atmosphere, in a short time became deliquescent. Tartaric acid produced an effervescence, and afterwards a precipitate in this solution; as likewise did muriate of platinum. From these experiments, therefore, it may be fairly inferred, that the alkali removed from the glass, was

potash in an uncombined state, and that the alkaline effect, obtained in the first instance, did not depend upon the presence of any alkaline salts, or combination, adhering to, or diffused throughout the glass. The remaining sediment from the above solution, after having been repeatedly washed in successive portions of water, became inert, as to its action on test papers, not affecting their colours, in the slightest degree; but upon *trituration* its alkaline power was again developed; this property being evidently dependent upon the exposure of a new, or undecomposed surface. A slight application of heat to the water, was found greatly to facilitate this evolution of alkali.

In order to determine the quantity of alkaline matter abstracted from a given weight of glass, by long and continued boiling, 100 grains of flint-glass, in fine powder, were boiled nearly every day for some weeks, in two or three successive portions of water; after this process, the insoluble residue was found deficient in weight by nearly seven grains. This result, however, must not be considered as accurate, but as a mere approximation: for on the one hand, small portions of glass might have been carried away in the supernatant liquor; and on the other, more alkali might have been abstracted by repeatedly triturating during the process, which, under these circumstances, would be almost unlimited.

To some pure, dilute, muriatic acid, was added very fine flint-glass in powder, till it was completely neutralized, by its alkaline effect. Upon being allowed to subside, (which, however, was not very readily effected, minute particles remaining suspended for weeks together,) the clear portion afforded a crystalline salt on evaporation, having the characters of muriate of potash.

It may be remarked, that this solution, when *perfectly clear*, contained no lead, on testing for it by sulphuretted hydrogen; but upon agitating, or diffusing the fine powder of glass through water, holding the gas in solution, it was immediately discoloured, or blackened.

Flint-glass, although chosen for the above experiments, is not the only variety, possessing this remarkable property; crown, and plate glass, white enamel, and, what is more remarkable, Newcastle, green bottle glass, and tube of the same material (in the composition of which there is, comparatively, little alkali,) also Reaumur's porcelain, made from the green bottle glass, possess the power of acting upon vegetable colours, as alkalies.

These experiments, tending to prove that glass is a body of irregular composition, parting readily with its alkali by the action of water, it became a matter of some interest, to determine how far certain natural combinations of potash with siliceous matter, were equally active to the same tests, especially as in green bottle glass, which contains little alkali, it is thus rendered evident. No analogous effect could, however, be produced by powders of felspar, basalt, greenstone, granite, obsidian, pumice, and some others, even when boiled with water, a method which never failed to produce it rapidly with glass, although cold water is perfectly sufficient.

Some interesting conclusions may be drawn from the above experiments, which may tend to explain some well known phenomena.

In the first place, with regard to the glasses employed, in the laboratory, or for domestic uses, it must be evident that water has the power of acting upon, and dissolving, the alkali at the surface, and leaving an insoluble portion, spread as a coating over the interior of the vessel, defending it from further immediate action.

Where, however, time can be allowed, the effect does not appear to be confined to mere surface. In collections of ancient glass, specimens may be selected, exhibiting how extensively an analogous action has been going on during the period they have remained buried in the earth. These vitreous relics of antiquity are often covered to a considerable thickness, with opal pearly scales of beautiful appearance, consisting, almost wholly, of silica, whose alkali had been removed, probably, by the action of water.*

A fragment of transparent ancient glass was examined with regard to its alkaline property, which it was found to enjoy in a high degree, being sensibly alkaline (when in powder,) to the tongue, and its hot solution acting upon the cuticle. It appeared to consist, almost entirely, of potash and silica; not the smallest trace of lead being discoverable in it; several other coloured specimens of ancient glass, upon examination, were, in every case, more highly alkaline than any modern glass containing lead, that has hitherto been examined.

The specific gravity of common flint-glass was taken, by way of comparison with the ancient fragments, above mentioned, the result of which is here given. Flint-glass, *s. g.*, 3.208. Ancient glass, 2.375. It may here be remarked, that the latter acted powerfully upon the test-paper, by merely moistening it, without reduction to powder. It cannot be surprising, therefore, that ancient glass, which may almost be called pure silicate of potash, should be occasionally found in states of such rapid decay, as the specimens in collections often exhibit.

Another proof of the action of water, aided by other concomitant circumstances, in producing decomposition upon glass, is an account given in vol. i. p. 135, of the Quarterly Journal of Science, of some bottles of wine, found in a quantity of black mud at the bottom of an old well, full of burned wood, supposed, upon good authority, to be of anterior date to the fire of London, (1666.)

The siliceous earth, in this instance, separated in films on the surface of the bottle, in consequence of the abstraction of alkaline matter, probably by the action of water, aided perhaps, originally, by a certain degree of heat, and afterwards, by the long period of their continuance, in a situation favourable to the decomposing agency.

In contact with ammoniacal, or decomposing animal matter, the disintegration of glass takes place more rapidly. Stable windows, and bottles kept in such situations, often present a very beautiful iridescent appearance, in consequence of the siliceous matter being

* The opal is a hydrate of silica. May not its formation have taken place by a similar agency acting upon natural combinations? The removal of alkali from siliceous compounds, may have left opal thus constituted.

developed in thin plates on its surface, often amounting to a pearly, and sometimes almost metallic appearance; an effect which, it is believed, has not been hitherto investigated.

Solution of potash acts very rapidly upon glass, as the chemist, often, inconveniently, learns by the effect produced upon the bulb of a thermometer employed to determine its boiling point, and which is always found corroded to a considerable extent after the experiment.

It may also here be remarked, (although not perhaps immediately connected with the subject,) that from frequent observations of a person, in the habit of using solid carbonate of ammonia, the flint-glass bottles in which it has been for some time kept, are invariably rendered much more brittle, and pieces of glass fall out upon very slight motion of its contents. This fact is merely mentioned as curious, and may, probably, be hereafter more fully examined.

[*Journal of the Royal Institution.*

ESSAYS ON BLEACHING.

By James Rennie, A. M. Lecturer on Philosophy, &c. &c. London.

No. III.—CHEMICAL AGENTS USED IN BLEACHING.

SECTION III.—*Of the Mineral Alkali.*

SODA is procured in a similar manner with potash, by incineration, and afterwards lixiviating; but from vegetables of a very different habitat. Potash is manufactured chiefly from trees; while soda, when it is procured from vegetables, is made exclusively from marine plants. Sometimes it is found native, as in Russia, and in Egypt, where it is called natron. But, however much it may differ from potash, in its appearance, and in the plants whence it is obtained, when used as an agent in bleaching, there is little difference in its effects, provided that the strength of the ley, and other circumstances, shall be equal. Hitherto, the exorbitant price of this commodity has excluded it from being used in the bleach-field; but as more economical modes are now contrived, and as it is made of great purity, there is little doubt that it will now soon be introduced, particularly as it is admirably calculated for the finishing process of the finer fabrics of muslin. Ramsay, from whom I take these remarks, adds, that six ounces of pure carbonate of soda, with ten ounces of soap, produce detergent effects equal to a pound and a half of soap used alone. The oxymuriate of soda, as will afterwards be detailed, is sometimes used in calico bleaching, and must require this alkali in a crude state, for its manufacture.

Barilla is obtained chiefly on the shores of the Mediterranean, from the salsola kali, the salicornia, and the chænopodia of Linnæus, which are dried to the same degree as hay, and burned in pits, like those used with us for kelp, which reduces them to a grayish-blue

mass, containing more or less mineral alkali. When broken, it presents a blackish fracture. It usually contains from 20 to 24 per cent. of pure alkali; but the superior sort of it, called sweet barilla, sometimes contains 33 per cent. The contaminating substances, are charcoal, and sulphate, or muriate, of soda.*

This alkali is also manufactured in Britain from marine plants, chiefly fuci, which grow on our shores. It is called kelp, and is much inferior to the barilla imported from Alicant and Carthagena, containing only from three to eight per cent. of pure alkali. Its inferiority has been ascribed, and apparently with much justice, to the rude and careless manner in which it is commonly manufactured. (See Jamieson's M. of the S. Isles, vol. II. 44.) Sulphur commonly exists in a considerable proportion in kelp. Mr. Kirwan found this proportion as high as four grains in the ounce, in the best Cunnamara kelp, and that of Strangford seemed equally sulphurous. (Trans. R. I. Acad. III. 23-4.)

Before stating the mode of analyzing barilla and kelp, it may not be improper to mention a prejudice, which commonly influences bleachers in purchasing those commodities, and which is founded on a mistaken view of their chemical properties. When a parcel of those crude alkalies has lain in the storehouses for any considerable length of time, the action of the air causes the larger pieces to break down, and to assume a very different appearance from those recently imported. When the ignorant bleacher sees this, he sets a very inferior value on the goods, and frequently refuses to have them at any price. Now, chemistry teaches us, that the fixed alkalies are imperishable, and cannot be injured by keeping, except they be dissolved by moisture, or washed away by rain. The only circumstance which could depreciate alkalies, in the state just described, is their absorption of carbonic acid and water, whose proportions can be easily ascertained, and the consequent depreciation of value deducted. Nay, these alkalies are rather improved, for the purposes of bleaching, by age; for, by the absorption of carbonic acid, the alkaline sulphuret which they may have contained, is decomposed, and the sulphur separated; whence a much purer ley can be obtained, than from barilla or kelp, recently procured.

I am of opinion, that this mistaken notion, concerning alkalies, may have arisen from a remark made by Dr. Home. (Exper. p. 158.) "These ashes," he says, "ought to be close shut up in casks; for, if exposed to the open air, though in a room, the alternate moisture, and drought, must fix their most useful parts. They become less pungent by keeping, and that on the outside, while their pungency remains

* Some very peculiar doctrines are stated by Mr. Parkes, respecting barilla. He says, that all marine plants, except those cultivated for barilla, yield potash, and not soda, by incineration. He was led into this opinion, by obtaining great quantities of muriate of potash from kelp, to the extent even of many hundred weights per ton. He imagines, that the soda, of kelp, is not derived from the burnt weeds, but from the operation of the potash on the sea salt, producing a decomposition, forming carbonate of soda, and muriate of potash.
Chem. Catech. p. 158.

internally!" And again, (p. 47,) "Muscovy ashes turn weaker every day, till at last they become quite effete." This is obviously from the absorption of carbonic acid; and he does not seem to have known, that this could speedily be extracted by quick lime.

I would earnestly advise the bleacher, in no case to trust to tables for ascertaining the qualities of the alkalies he is about to purchase. Such have been given by Kirwan, and Descroizilles, senior; but they are calculated only to mislead; for every parcel of the crude articles of commerce, differs in its proportions of real alkali, even supposing it to come from the same manufactory. He must ascertain for himself the purity of every parcel, if he wishes to profit by his business. Barilla and kelp may be examined in the same manner which has been already directed for trying potash, or by the method which I shall here lay down, and for which I am indebted to Mr. Parkes.

When any parcel of kelp, or barilla, is to be analyzed, as fair an average sample as possible is to be selected, by breaking small chips from several large pieces, and mixing those with a fair proportion of the small, which may belong to the lot. Let a sample, thus selected, be pulverized in an iron mortar, that the whole may be equally mixed; about an ounce of this is to be ground to an impalpable powder, to facilitate the disengaging of the pure alkali. Take of this powder, 100 grs., and pour upon it two ounces of pure water; stir it occasionally for a few hours, with a glass rod; allow the insoluble matters to subside; pour the supernatant liquid on a paper filter; and add other two ounces of water to the residuum. The whole is then thrown on the filter, in order to secure any lime, or carbonate of lime, which may be present, and would occasion inaccuracy; upon which a little water is also poured, to wash out what remains in the residuum. Both the filtered solutions are then to be put into a vessel, and reduced, by boiling, to two or three ounces. Take two ounces of diluted sulphuric acid, of the specific gravity of 1.100; weigh it accurately, together with the phial, and note down their weight in grains. Pour some of this acid, very gradually, into the solution, and stir it till it ceases to effervesce; when, if it turn red litmus paper blue, more acid, say a drachm, is to be cautiously added, and after stirring, it is to be again tried with the test paper. When the paper begins to be affected but slightly, the acid should only be added by a few drops at a time. The complete saturation of the solution with acid, will be known from the effervescence wholly ceasing; the separation of the sulphur held in solution; and from its not tinging the test paper. The alkali having thus been rendered neutral, the acid in the phial, which has not been used, is to be again accurately weighed, to ascertain how much it has required to saturate the alkali; whence it can easily be calculated, how much real alkali the sample contained, when it is known how much acid a pure alkali will take up. Mr. Parkes ascertained, that 100 grains of pure potash require 520 grains of sulphuric acid, of the specific gravity of 1.100, to saturate it; and 100 grains of pure soda require 812 of the acid. From this, it is evident, that, before commencing the analysis, it will be necessary to learn whether the sample is potash, or soda, or a mixture of both

The crystals of nitro-muriate of platina, dissolved in water, will furnish a test for this purpose; as, when it is dropped into any alkaline solution, it will precipitate potash, but will not affect the soda.

Recovery of Alkali from Waste Leys.

It is a very bad practice among bleachers, and it is almost universal, to use, again and again, the alkaline leys, which must be loaded with impurity: they are often so much so, indeed, as to approach to coagulation. They are led to this, from a notion of economy, being unwilling to throw away any alkali which they can any way employ. But it would often be more economical to purify the ley, before using it; and a method of doing this is also a desideratum for procuring fresh alkali from leys which can no longer be used. Several plans for this purpose have been suggested, but few have been successful, or, at least, economical. Des Charmes advises the residual ashes to be moistened with the ley, and burned in a common kitchen fire, in which wood is the usual fuel. He also recommends boiling the waste leys with quicklime, which is found to be one of the best ways of management, as the lime decomposes the impure vegetable matter floating in the leys, and renders them transparent and caustic, though not altogether so pure as fresh made ley. (See Art of Bleach. p. 558.) This is chiefly practicable, however, when the leys have been used for cottons; for the resinous extract of linens is not so easily acted on by the lime, without adding, along with the lime, as may easily be done, a small quantity of the fresh precipitated earth of alum. The mixture should be constantly agitated during the process, in order to expose every particle of the resinous and extractive matter to the action of the lime. Des Charmes, in this, gives directions quite opposite from those practised by the bleachers around Glasgow. They find that the lime acts better in a cold solution, than with the addition of heat. (See Ramsay's Treatise.) Another mode is by calcining the waste leys in a reverberating furnace, or in the apparatus called the stone boiler, already described; and by these means, alkali can thus be obtained purer than that which is imported; which, in extensive bleach-works, that can afford the expense of the apparatus, is of great consequence. The ley is first evaporated, till it becomes of the consistence of treacle, (see Des Charmes, p. 92,) when it is put into the furnace, or boiler, where, being dried, it takes fire, and burns vividly. The mass is thus melted, and is found to consist of pure alkali; for all the resin and extractive matter are completely consumed; and the carbon, formerly taken up from the cloth, reduces the sulphate of potash to the state of a carbonate, and this carbon is again taken up by the quicklime, used to render it caustic; so that it is nearly in a state of purity. If boilers are used, their safety should be insured by the ingenious method recommended by Mr. Ramsay, of Glasgow. (See Ann. of Philos. I. 258.)

The home manufacture of alkalies, is but slightly connected with the direct subject of the sketch; yet, I cannot help remarking, that it ought to be carefully attended to. We are indebted to Spain, for an

annual supply of several thousand tons of barilla, and to America and Russia, for incalculable quantities of pot and pearl ashes; while we possess considerable resources at home, which are either altogether neglected, or ignorantly and unskilfully managed. The French, with the most laudable spirit of industry and enterprise, take advantage of their wine leys, to prepare an ash (Cendre Gravelées) from the leys of wine, which contains no less than 60 or 70 per cent. of pure alkali, (Des Charmes, p. 279.) We cannot, indeed, for want of material, produce this alkali; but let us turn to account the resources we possess. Let endeavours be made to improve the kelp manufacture, by constructing proper furnaces for its combustion, and by preparing the sea-weeds, whence it is to be made, according to well ascertained chemical principles. Let the furze, broom, and fern, which grow in such great abundance in some of our waste lands, be turned into potash; or let such plants as best afford alkali, be cultivated expressly for its manufacture. The tansey (Tancetum vulg. Lin.) is, according to Lord Dundonald, one of those; and as it grows in abundance in a wild state, on the banks of the Clyde, it is highly probable that its cultivation would be extremely easy. Potash may be procured from saltpetre, by heating it with charcoal, so as to decompose its acid. In this way, we are told by Parkes, that one hundred weight of the nitre will produce half that quantity of pure potash. During our late disputes with America, a great quantity of saltpetre was used for this very purpose; and when the prices will admit of it, considerable profit may in this way be gained. Potash may also be made from peat ashes.

On the Theory and Practice of Cider making.

By a CORRESPONDENT.

Exeter, Aug. 9, 1826.

SIR—In making cider, very much indeed depends on the management, as from the same fruit, ciders very different in colour, and in quality, may be produced: for instance, if the apples are ground down and submitted to the action of the press at once, then committed to the vat, and there fermented, the cider will be harsh, and nearly colourless: but, if apples from the same tree, and gathered at the same time, are ground down in the latter part of the day, and not committed to the press till the following day, the action of the air on the pulp will cause the cider to acquire a considerable degree of colour.

For making strong Ciders the process is as follows:—A layer of wheat-straw is placed on the bottom of the press in a square form, and on this a layer of the pulp of about an inch in thickness; a second layer of straw is then placed on this, but in a contrary direction to the former, and so as to lie across it at right angles; and then another layer of the pulp, and so on alternately; layers of straw and pulp are continued, until as much is put in as you propose to submit to the action of the press, at once. The press is now brought down

on it, until a few quarts of juice are expressed, and the sides of the mass (called the cheese,) are pared with a hay-knife, into a regular square. The press is then raised, the parings are laid on the top of the cheese, the juice which had been expressed is poured on its centre, that it may again pass, and thus become fine; the press is again brought down, and about one third of the cider forced out: it is then suffered to remain until the evening, when the press is raised and the cider carried to the vat; the cheese is now pared round, by first cutting off its angles, and making it octangular, and then dressing it round, by paring off thin slices, all which parings are again placed on its top, and the press again brought down, and more of the cider forced out; and this process is continued, until the cheese is very much reduced in diameter, care being taken so to pare it, that its centre continues directly under the centre of the screw of the press. By this process of paring, the kernels of the apples are cut by the knife, and this gives the peculiar flavour to the cider; and by thus continually reducing the diameter of the cheese, the power of the press is continually increased, and this ensures the complete expulsion of all the juice. The juice is then transferred to the vat, which is a vessel of sufficient capacity to contain the product of one cheese, be it one or five hogsheads: after the liquor has been a little time in the vat, it will begin to sparkle, which will rapidly increase, until it arrives to an apparent ebullition, which at length subsides; and the cider thus fermented, is racked off into the vessels intended for its reception, where it soon completes its fermentation; care being taken every day, to keep it filled up, until such fermentation has ceased, when it is bunged down, and a small hole kept open a little time longer, which is finally stopped by a peg. Cider thus prepared will be highly coloured, of good flavour, and very strong.

For preparing sweet, luscious Cider:—As much should be drawn from the cheese at once, as will, after depuration in the vat, nearly fill the vessel intended for its reception. This is to be placed in the vat, which must not be quite filled. As the whole of this process consists in checking the fermentation, care must be taken to draw it off from the lees, the very instant of its commencement, and this cannot be known by sight; as should we by any accident delay drawing it off from the lees, until the sparkling we before noticed, has made its appearance, it would then be too late, the lees having by that time again begun to incorporate with the liquor; and these lees, containing the fermenting principle, the fermentation will proceed rapidly, and go on until it has quite destroyed the whole of the saccharine matter, which it is the intention of this process to preserve. Resort must therefore be had to some other method of discovering symptoms of approaching fermentation; and this is found in the carbonic acid gas, which all fermenting matters throw off, from the very commencement of the process. After the liquor, therefore, has stood in the vat about sixteen hours, a small bit of candle is fixed on the end of a wire, which is turned up for that purpose; this candle being lighted, is let gently down from the edge of the vat, until it comes in contact with the surface of the cider, and if it continues to burn

clear, it is considered that it is not time to draw it off; it being desirable that it should remain in the vat, as long as is consistent with safety, that it may deposit as much of its feculence as possible. It is therefore tried with the candle, as before, every hour, until it is perceived that the candle on approaching the surface of the cider, burns dim, which it will do, as soon as the carbonic acid gas begins to form, and will often be extinguished by it. This gas being heavier than atmospheric air, always floats on the surface of the cider. Immediately this sign is discovered, which generally happens after the cider has stood in the vat from sixteen to twenty-four hours, the cider is carefully drawn off, so as not to disturb the lees, and transferred into a hogshead, which must not be quite filled; in about a week after this, the above experiment with the candle must be repeated, by introducing it into the bung-hole of the hogshead, and this should be attended to every five or six hours, until the symptom of approaching fermentation is again discovered, when the cider is to be again drawn, or as it is called, racked off, into another hogshead, where it, in general, remains without further racking, until a year has passed over it; although some sorts of cider will require another racking, after about three weeks from the last, but this generally happens where the former operations were a little neglected.

Ciders thus managed, retain all their sweetness, and are, many of them, superior to most of the white wines.

I remain, sir,
Your most obedient servant.
EXONIENSIS.

To T. GILL, *Esq.*

[*Technical Repository.*

Enquiries, and Observations, on the Comparative Power of Steam Engines.

TO THE EDITOR OF THE LONDON MECHANICS' MAGAZINE.

SIR—As a great deal has been said from time to time, respecting the most accurate mode of calculating the horse power of a steam engine, I beg to make the following statements for the information of your intelligent readers.

Boulton and Watt, Mr. Maudsley, and Mr. Fawcet of Liverpool, have each lately finished, and set to work, in three steam vessels of similar tonnage, three pairs of 70 horse power engines. The two 70s, furnished by Boulton and Watt, are of the following dimensions.

	In.
Diameter of each cylinder	44½
Length of the stroke	54
Those by Maudsley are,	
Diameter of each cylinder	47
Length of the stroke	54

By Mr. Fawcet of Liverpool are,

Diameter of each cylinder	46¾
Length of the stroke	51

Query. Which of these are the most correct in their proportions.

A SUBSCRIBER.

Comparative Proportions of Steam Engines.

SIR—Your correspondent who has stated, as above, the diameters of the cylinders, and lengths of stroke of three steam engines of 70 horse power, lately made for steam vessels by Messrs. Boulton and Watt, Mr. Maudsley, and Mr. Fawcet, has omitted to mention the number of strokes which the different engines are intended to make per minute; this is an essential particular for any computation on the power which an engine can exert; for other circumstances being similar, the powers of steam-engines will be proportionate to the quantity of steam expended by them in a given time; so that a smaller cylinder, whose piston moves quicker than that of a larger one, may exert a greater power.

The proportions originally established by Mr. Watt, for the cylinders of his engines of different powers, are such as to allow 33.1 cubic feet of steam per minute, to produce each horse power.

For instance, his 40 horse engine had a cylinder 31½ inches diameter, and the piston made 17½ double strokes per minute, of 7 feet each, so that it passed through 245 feet per minute. The area of a circle, 31½ inches in diameter, is 779 square inches, or 5.41 square feet, which, multiplied by 245, gives 1325 cubic feet of steam expended per minute, by the motion of the piston, without making any allowance for the extra quantity expended by waste of condensation, or leakage. This is at the rate of 33.1 cubic feet per minute for each horse power.

Again, his 20 horse engine had a cylinder 23¾ inches diameter, its piston made 21½ strokes per minute, of 5 feet long; or it moved 215 feet per minute; the expenditure of steam was 662 cubic feet per minute, or equal to 33.1 cubic feet per minute for each horse power.

This allowance has been followed ever since by Messrs. Boulton and Watt in their large engines for manufactories, though they have, in many cases, reduced the lengths of the strokes, and enlarged the diameter of the cylinders; for instance, their modern 40 horse engine has a cylinder of 32½ inches diameter, and the piston makes 19 double strokes per minute, of six feet each, or it moves 228 feet per minute, which is an expenditure of 1304 cubic feet of steam per minute, or a little less than Mr. Watt's old engine, though the cylinder of the latter is smallest.

If 33 cubic feet per minute is allowed for each horse power, then the effective pressure upon each square inch of the piston, will be 6.944 pounds per square inch, without any deduction for friction or imperfect exhaustion. The following rule is adapted to this proportion.

*To find the power of a steam engine, on Mr. Watt's principle, in horse power.**

RULE.—Multiply the square of the diameter of the cylinder in inches, by the motion of the piston in feet per minute, and divide the product by 6050; the quotient is the power of the engine in horse power.†

Example.—Cylinder 23¾ inches diameter, squared = 564 circular inches area, × 215 feet motion per minute, = 121,260 cylindrical inch feet of steam expended per minute, –:– 6050 = 20 horse power.

The calculation may be conveniently performed by the two lines marked C and D upon a sliding rule, when the slider is set in the following manner:—

Sliding Rule. { C feet per min. / D 246‡ } Horse power of Eng. / Diam. of cylin. inch.

The above may be depended upon as an authentic rule for Mr. Watt's engines on shore. It should be observed, that a properly constructed engine, with a sufficient boiler, is capable of exerting full half as much more as its nominal power; so that a 40 horse engine, with a suitable increase of fuel, is able to do the work of 60 horse power, or a 20 horse engine can exert 30 horse power. In this respect, the old engines, such as were constructed by Mr. Watt himself, are greatly preferable to their descendants of the present day, which in performing their evolutions with a more quiet motion, have lost much of the activity of their noisy progenitors.

In steam-vessels, it would be useless to load the vessel with any more weight than is absolutely necessary, and hence it is the universal practice to urge the engines on board such vessels, to their very utmost power, the throttle valve being always kept fully open, when the vessel is under weigh; and as such engines have an unlimited command of cold water for condensation, they may be considered as always exerting half as much more power as they are rated at, or that two 40 horse engines, always exert 120 horse power; two fifties, 150 horse power; two sixties, 180 horse power; and two seventies, 210 horse power. The best steam-boat engines, exceed even this proportion, considerably.

If your correspondent can state with certainty, the number of strokes each of the seventy horse engines is intended to make, the diameters of their paddle-wheels, the length and breadth of those paddles, their number, how much they dip into the water, and the dimensions and draft of water of the vessels, their names, the ser-

* A horse power is that exertion of moving force which, besides overcoming all friction, will raise 33,000 pounds weight one foot high per minute; or any smaller weight a proportionably greater height in the same time.

† The divisor, 6050, is the number of cylindrical inch feet (i. e. small cylinders one inch diameter, and one foot long) that are contained in 33 cubic feet; for a square foot contains 183.346 circular inches × 33 = 6050.42.

‡ The number 246, which is used as a guage point on the line D of the sliding rule, is the square root of nearly ten times 6050 or 60,516; or the number 77.78 which is the square root of 6050, may be used for the guage points, and will give the same result as 246.

vices they are employed in, the speed with which they move through still water, and any other particulars, it would be very useful and interesting to many of your readers.

I am, &c. X.

P. S. I have been told that Mr. Maudsley's cylinders are 46½ inches, but your correspondent says 47.

On the relative proportions of the various parts of the Boulton and Watt's, or low pressure, Steam Engine; the fuel required for working engines of different powers, and the effect produced, in Pumping Water, or Grinding Wheat.

We have been furnished with a copy of a table containing the very important results of the experience of Boulton and Watt, in proportioning the most essential parts of their steam engines, together with some other particulars, a knowledge of which ought to be possessed, not only by the manufacturer of those machines, but also by every engineer. This table has never before appeared in print, but manuscript copies of it are possessed by the principal engineers of Great Britain, from one of whom it was procured, by an American engineer, who has recently visited that country.

The preceding article on the comparative proportions of steam engines, which we have extracted from a late number of the London Mechanics' Magazine, is, manifestly, written by a person well acquainted with the subject upon which he treats, and will, in several respects, be a useful introduction to this table, which we have subjoined.

In these tables, the calculations, it will be seen, are made for steam of two pounds to the square inch, and when the pressure is greater, the calculations must, of course, be so modified as to suit this variation. For the sake of the general reader, it may be well to observe, that by two pounds to the square inch, is intended two pounds above the ordinary pressure of the atmosphere, making, of course, about 17lbs. on every square inch of the surface of the piston. If the pressure exceed four pounds upon the square inch, it is no longer a true low pressure engine; and, in this country there are very few of this kind. Those denominated low pressure, and used on board our steam boats, work, ordinarily, under a pressure of from 7 to 14lb. upon the inch, and, as the boilers are made strong in proportion, and varied in their form, so as to sustain this pressure, they are, under proper management, equally safe with those of lower pressure.

The table supposes the working pressure upon every square inch of the piston, to be equal to ten pounds; but in the low pressure engine, it would be accounted a good average to equal one half of the elastic power of the steam, which at 17lb. to the inch, would amount to 8½lb.; one half the power being expended in overcoming friction and inertion, and in unavoidable imperfections in workmanship.

Editor.

Boulton & Watt's calculation of Steam Engines.

(Steam two pounds to the square inch.)

No. of Horses Power.	CYLINDER.			STROKES.	
	Inches Diameter.	Inches area.	Inches Contents.	Length.	No. per minute.
1	6	28.274	508.932	1.6	60.
2	9	63.617	1526.808	2.	50.
4	12	113.1	3393.	2.6	40.
6	14	153.94	5541.84	3.	33.3
8	16	201.062	8444.52	3.6	28.571
10	17.5	240.53	11545.44	4.	25.
12	18.75	275.117	13205.616	4.	25.
14	20.2	320.474	17305.596	4.6	22.2
16	21.5	363.65	19604.7	4.6	22.2
18	22.8	408.28	24498.	5.	20.
20	24.	452.4	27144.	5.	20.
22	25.2	498.76	29925.6	5.	20.
24	26.3	543.41	35865.06	5.6	18.18
26	27.3	585.35	38633.1	5.6	18.18
28	28.4	633.5	45612.	6.	16.6
30	29.5	683.5	49212.	6.	16.6
32	30.3	721.08	51917.76	6.	16.6
34	31.2	764.54	59634.12	6.6	15.38
36	32.2	814.34	63518.52	6.6	15.38
38	33.1	860.5	72282.	7.	14.28
40	34.	908.	76272.	7.	14.28
42	34.75	948.42	79667.28	7.	14.28
44	35.6	995.4	91576.8	7.6	13.3
46	36.4	1040.62	95737.04	7.6	13.3
48	37.2	1086.87	104339.52	8.	12.5
50	38.	1134.12	108875.52	8.	12.5
52	38.7	1176.29	112923.84	8.	12.5
54	39.5	1225.42	124992.84	8.6	11.7647
56	40.2	1269.24	129562.48	8.6	11.7647
58	40.8	1307.	141156.	9.	11.
60	41.6	1359.18	146791.44	9.	11.
62	42.25	1402.	151416.	9.	11.
64	43.	1432.2	154677.6	9.	11.
66	43.6	1493.014	161145.08	9.	11.
68	44.25	1537.86	166088.88	9.	11.
70	45.	1590.44	171767.52	9.	11.
72	45.6	1633.13	176378.04	9.	11.
74	46.25	1682.02	181658.16	9.	11.
76	46.8	1720.21	185782.68	9.	11.
78	47.5	1772.06	191382.48	9.	11.
80	48.	1809.56	195432.48	9.	11.
82	48.6	1855.08	200348.64	9.	11.
84	49.2	1901.17	205326.36	9.	11.
86	49.8	1947.82	210364.56	9.	11.
88	50.4	1995.04	215464.32	9.	11.
90	51.	2042.725	220614.3	9.	11.
92	51.5	2083.077	224972.316	9.	11.
94	52.	2123.72	229361.76	9.	11.
96	52.6	2173.	234404.	9.	11.
98	53.2	2222.87	240069.96	9.	11.
100	53.75	2269.07	272288.40	10.	10.

Boulton & Watt's calculation of Steam Engines.

(Steam two pounds to the square inch.)

No. of Horses Power.	AIR PUMP.				CONDENSER
	Inches Diameter.	Inches area.	Stroke.	Contents.	Contents ½ of Cylinder.
1	4.	12.5664	.9	113.1	170.
2	6.	28.2744	1.	339.3	509.
4	8.	59.2656	1.3	714.	1131.
6	9.3	76.93	1.6	1334.74	1847.28
8	10.6	88.25	1.9	1853.25	2814.5
10	11.6	105.683	2.	2536.402	3848.5
12	12.3	118.823	2.	2851.756	4401.872
14	13.3	139.93	2.3	3751.11	5768.532
16	14.3	160.606	2.3	6336.374	6535.
18	15.2	181.459	2.6	5445.77	8166.
20	16.	201.062	2.6	6031.872	9048.
22	16.8	221.671	2.6	6650.138	9975.2
24	17.53	241.354	2.9	7964.686	11955.
26	18.3	263.02	2.9	8679.74	12877.7
28	18.93	281.444	3.	10131.987	15204.
30	19.66	303.57	3.	10928.52	16404.
32	20.2	320.474	3.	11537.086	17306.
34	20.8	339.8	3.3	13252.2	19878.
36	21.5	363.05	3.3	11459.	21172.84
38	22.	380.1336	3.6	15965.6112	24094.
40	22.6	401.151	3.6	16848.342	25424.
42	23.13	420.186	3.6	17647.835	26555.76
44	23.73	442.269	3.9	19902.105	30525.6
46	24.3	463.77	3.9	20869.68	31912.35
48	24.8	483.052	4.	23186.516	34780.
50	25.3	502.7267	4.	24130.8809	36291.84
52	25.8	522.8	4.	25094.4	37641.28
54	26.3	543.41	4.3	27713.93	41664.28
56	26.8	563.1	4.3	28718.39	43187.5
58	27.2	581.07	4.6	31377.8	47052.
60	27.73	604.	4.6	32616.	48930.5
62	28.16	622.81	4.6	33611.79	50472.
64	28.66	645.1241	4.6	34836.7016	51559.2
66	29.06	663.2574	4.6	35815.9	53715.
68	29.5	683.5	4.6	36909.	55363.
70	30.	706.86	4.6	38160.44	57255.84
72	30.4	725.835	4.6	39195.104	58792.68
74	30.83	746.514	4.6	40311.756	60552.72
76	31.2	764.54	4.6	41285.16	61927.56
78	31.6	784.27	4.6	42350.58	63794.16
80	32.	804.25	4.6	43429.5	65146.16
82	32.5	829.578	4.6	44797.252	66783.
84	32.8	844.9647	4.6	45628.0957	68442.
86	33.2	865.7	4.6	46747.8	70121.52
88	33.6	886.685	4.6	47881.	71821.44
90	34.	907.922	4.6	49027.809	73538.3
92	34.33	925.6323	4.6	49984.1445	74998.8
94	34.66	943.513	4.6	50949.716	76454.
96	35.	959.75	4.6	51827.	78134.66
98	35.46	987.571	4.6	53328.837	80023.32
100	35.83	1008.288	5.	60497.280	81616.52

Boulton & Watt's calculation of Steam Engines.

(Steam two pounds to the square inch.)

No. of Horses Power.	INJECTION WATER. Gallons per stroke.	Gallons per min.	BOILER Contents in gallons.	COALS for 12 hours. BUSHELS Empty.	Loaded.	Pumping	GRINDING. Winchester bush. wheat per hour.
1	.176	7.	24.5	.5	1.5	Ten pounds working pressure on the square inch of the piston, will raise water 20 feet by a pump of the same diameter, and stroke, with the piston.	1.885
2	.26	13.	49.	1.	3.		4.241
4	.5	20.	98.	2.	6.		7.54
6	.848	28.	147.	3.	9.		10.2
8	1.26	36.	196.	4.	12.		13.4
10	1.72	43.	245.	5.	15.		16.0353
12	2.	50.	294.	6.	18.		18.34
14	2.5675	57.	343.	7.	21.		21.
16	2.882	64.	392.	8.	24.		24.2154
18	3.6	72.	441.	9.	27.		27.88
20	4.	80.	490.	10.	30.		30.16
22	4.4	88.	539.	11.	33.		33.25
24	5.2805	96.	588.	12.	36.		36.2272
26	5.725	104.	637.	13.	39.		39.0232
28	6.9306	112.	686.	14.	42.		42.226
30	7.4257	120.	738.	15.	45.		45.567
32	7.9207	128.	784.	16.	48.		48.072
34	8.84	136.	833.	17.	51.		51.
36	9.36	144.	882.	18.	54.		54.2887
38	10.71	152.	931.	19.	57.		57.367
40	11.2	160.	980.	20.	60.		60.53
42	11.76	168.	1029.	21.	63.		63.2347
44	13.233	176.	1078.	22.	66.		66.36
46	13.834	184.	1127.	23.	69.		69.3747
48	15.36	192.	1176.	24.	72.		72.458
50	16.	200.	1225.	25.	75.		75.608
52	16.64	208.	1274.	26.	78.		78.4193
54	17.85	216.	1323.	27.	81.		81.6947
56	19.04	224.	1372.	28.	84.		84.616
58	20.9	232.	1421.	29.	87.		87.13
60	21.621	240.	1470.	30.	90.		90.612
62	22.342	248.	1519.	31.	93.		93.53
64	23.063	256.	1568.	32.	96.		96.
66	23.783	264.	1617.	33.	99.		99.33
68	24.504	272.	1666.	34.	102.		102.524
70	25.22	280.	1715.	35.	105.		106.03
72	25.945	288.	1764.	36.	108.		109.
74	26.6	296.	1813.	37.	111.		112.1347
76	27.3838	304.	1862.	38.	114.		115.
78	28.1171	312.	1911.	39.	117.		118.1373
80	28.82	320.	1960.	40.	120.		121.
82	29.549	328.	2009.	41.	123.		123.672
84	30.27	336.	2058.	42.	126.		126.7447
86	30.9	344.	2107.	43.	129.		129.8547
88	31.70	352.	2156.	44.	132.		133.
90	32.43	360.	2205.	45.	135.		136.18167
92	33.153	368.	2254.	46.	138.		138.8718
94	33.173	376.	2303.	47.	141.		141.5813
96	34.594	384.	2352.	48.	144.		144.87
98	35.315	392.	2401.	49.	147.		148.2
100	40.	400.	2450.	50.	150.		151.2713

Economical method of keeping Horses.

By Henry Sully, *M. D.*

Sir—If the following description is considered as of use to any of your numerous readers, I beg it may be inserted in your Mechanics' Magazine, as the best mode I can devise of diffusing, most extensively, a plan I am daily requested to describe, and which, for above 17 years, I have invariably followed with a success that most of my neighbours have witnessed, and. as a thorough good chaff-cutter, and corn-bruiser, are matters of high importance, we may be favoured with improvements which some of your correspondents have instituted.

I am, Sir,
Your obedient Servant,
Henry Sully, M. D.

When the scarcity of horse provender renders it so expensive, as it is likely to prove the ensuing winter, one cannot do a greater service to his countrymen, than by pointing out to them, a plan by which their expenses may not only be lessened, but their cattle kept in better condition.

Having received innumerable letters from gentlemen who keep horses, requesting a description of my plan of feeding, I shall save much future trouble, both to others as well as myself, by laying my system before the public. Having pursued the plan above 17 years, I am enabled to appreciate its full value, and, being perfectly satisfied of its superior excellence, I hope to continue the same as long as I keep horses. Most people who know me will allow, that horses in my employ enjoy no sinecure places, and few people can boast of their cattle being in better working condition, or more capable of laborious undertakings, than mine.

The loft above my stable contains the machinery for cutting chaff, and grinding corn. From this loft each horse has a tunnel of communication with the manger below, and a tub annexed to each tunnel in the loft for mixing the ingredients composing the provender. There should be no rack in the stable, because this may tempt the groom to fill it with hay, and thus, by overloading the horse's stomach, endanger his wind, to say little of its expense and waste, for it is a well known fact, that if a horse has his rack constantly replenished with hay, he consumes, and spoils, upwards of 30lb. per day; whereas in chaff, his utmost allowance is 10lb. in 24 hours. The manger with which the tunnel communicates, should have cross bars, of firm oak, placed at the distance of 10 or 12 inches from each other, to prevent the horse from wasting his provender in search of the grain it contains, and this space between the cross bars, allows the horse plenty of room to take his food.

The chaff-cutter I make use of, is manufactured by Mr. Wilmott, a very ingenious mechanic, who resides about five miles from Taunton, on the road to Wiveliscombe. He also provides corn-bruisers

upon the best construction, and any person keeping three or four horses, will save the prime cost of his machinery the first year of its trial, and the horses themselves, thus fed, to use the language of horse keepers, will always be above their work.

When the provender is thoroughly mixed in the tub, previously weighing out each ingredient, the mixture should be given in small quantities at a time, many times in a day; and, at night, enough is thrown into the tunnel, to last till the morning. This process will be found of very little trouble to the groom, who will only have to go into the loft six or eight times a day. As the component parts of the provender are weighed out separately for each horse, we are certain he has his just proportion; and I have hereunto annexed my scale of feeding, in four classes, for it sometimes so happens, that some of the ingredients cannot be procured, and, at other times, that it may be better to substitute others; but, whatever grain is given, it should always be bruised, or coarsely ground, and carefully weighed out; for by weight, alone, is it possible to judge of the quantity of farinaceous substances the horse consumes; it being well known, that a peck of oats varies from seven to twelve pounds; consequently, if the provender were mixed by measure, there would be frequently an uncertainty, as to quantity. Wheat varies from 16 to 12. Barley, from 13 to 10. Pease, from 17 to 15. Beans, from 17 to 15 per peck. And, as wheat, beans, pease, barley, and oats, are equally good, and of very trifling difference in price, when their specific gravity is taken into consideration, I am equally indifferent which grain I use, but I should always prefer boiled, or steamed, potatoes, for hard working horses, to be a component ingredient, whenever they can be procured.

As I call all ground or bruised grain, of whatever description, *farina*, it will be so distinguished in the following

Scale.

	Class 1.	Class 2.	Class 3.	Class 4.
Farina, consisting of bruised or ground beans, pease, wheat, barley, or oats,	5 lb.	5 lb.	10 lb.	5 lb.
Bran, fine or coarse pollard,	—	—	—	7 lb.
Boiled or steamed potatoes, mashed in a tub, with a wooden bruiser,	5 lb.	5 lb.	—	—
Fresh grains,	6 lb.	—	—	—
Hay, cut into chaff,	7 lb.	8 lb.	10 lb.	8 lb.
Straw, or reed, in chaff,	7 lb.	10 lb.	10 lb.	8 lb.
Malt dust, or ground oil cake,	—	2 lb.	—	2 lb.
Salt,	2 oz.	2 oz.	2 oz.	2 oz.

By the above scale, it will be seen, that each horse has his 30 lb. of provender, in 24 hours, which, I maintain, is full as much as any horse ought to eat, and is more than some can eat. The two ounces of salt will be found an excellent stimulus to the horse's stomach, and should, on no account, be omitted. When a horse returns from labour, perhaps the groom will see the propriety of feeding him from his tub more largely, in order that he may be the sooner satisfied, and lie down to take his rest.

Whenever oat straw can be procured, it is generally preferred; and some like to have it cut into chaff, without threshing out the oats; but this is a bad plan, for, in preparing a quantity of this chaff, unequal proportions of oats will be found in each lot, so that one horse will have too large a portion, whilst others have less than they ought, although the portions are accurately weighed.

The only certain method, then, is to let the grain, of whatsoever description, be weighed separately from its straw, and the keeper of horses will soon satisfy himself, that his cattle are in want of nothing in the feeding line. Many people object to potatoes, and think them unfit for working horses; but, from many years' experience, I am enabled to recommend them as a constituent part of the 30 lbs., and am convinced, that it is as wholesome and nutritious a food, as can be procured for labouring horses, which are called, upon sudden emergencies, to perform great tasks, as has been abundantly proved by Mr. Curwen, M. P., who kept above one hundred horses on potatoes and straw, and always found that their labours were conducted better on this, than any other food.—See Curwen's Agricultural Hints, published in 1809. HENRY SULLY.

Wiveliscombe, Somerset, Sept. 12, 1826.

[*Lon. Mech. Mag.*

On Automata and Androides.

BY THE EDITOR.

IT is not our intention to attempt even a bare enumeration of all the Automata and Androides, which have been exhibited to the public, and are described in different works, as articles of great curiosity; this would lead us far beyond the limits, within which we must necessarily confine this article: nor is it intended, now, to describe the mechanism by which any of these instruments were moved; but merely to gratify curiosity, by some account of the performances of a few of those which have been among the most celebrated.

M. Camus has given an account of an ingenious piece of mechanism, which he constructed for Louis the XIV. when a child. It represented a lady proceeding to court, in a small chariot drawn by two horses, and attended by her coachman, footman, and page. When the machine was placed at the end of a table of a determinate size, the coachman smacked his whip, and the horses started off, exhibiting all the natural motions of that animal, and the whole equipage drove on to the further extremity of the table; it now turned at right angles in a regular way, and proceeded to that part of the table opposite to which the prince sat, when the carriage stopped, the page alighted to open the door, and the lady came out with a petition, which she presented, with a curtsey. After waiting some time, she again curtsied, and re-entered the carriage; the page then resumed his place, the coachman whipped his horses, and the footman, after running some time after the carriage, jumped up behind it.

Such is the account given by the maker of this ingenious toy; he has not, however, described the mechanism, by which the different motions were produced; and we doubt very much, whether a view of the thing in action, were it now before us, would justify the expectations, which the account appears to be intended, and is certainly calculated, to excite. The different figures must necessarily have retained their connexion with the carriage, and what is said about the running of the footman, and the movements of the other figures, is, undoubtedly, an exaggeration, as is usually the case, on subjects of this description.

M. Vaucanson, a member of the Royal Academy of Sciences, in France, constructed various pieces of mechanism, of a very superior class. In the year 1738, he exhibited in Paris, a machine capable of performing various airs upon the German flute. A very exact account of the structure of this instrument, was communicated by him to the Academy, which account was published in their Transactions; an abstract of this may be found in Rees' Cyclopedia, or the Edinburgh Encyclopedia, under the articles Androides, and Automaton.

This figure was about five and a half feet in height; it stood upon a pedestal of four and a half feet in height, within which were contained the bellows, which supplied the wind, and the clock-work, by which they were driven; the whole so carefully constructed, that not the slightest noise was made by any of the moving parts. The fingers, the lips, and the tongue of the figure, had each their proper motions; which were regulated with the utmost precision, by means of levers and chains, acted upon by the rotation of a steel barrel, furnished with pins for that purpose.

The same gentleman, in 1741, produced, and exhibited to the Academy, another figure, which played upon the pipe and tabor; it was, like the flute-player, fixed upon a pedestal, and was habited as a dancing shepherd: it was capable of playing about twenty tunes, consisting of dances of various kinds. This mechanism was not less admired than the flute-player; for, although it might, at first, appear, that. from the simplicity of the instruments played upon, the motions would be more readily given, yet the fact is far otherwise. The shepherd's pipe is one of the most imperfect, and untoward, of all musical instruments; it has only three holes, and the variety of its tones depends chiefly upon varying the force of the wind, and upon covering the orifices more or less perfectly. These variations in the force of the wind, must be given with a rapidity which the ear finds it difficult to follow, and the articulation of the tongue must be communicated to the quickest notes, otherwise the instrument is disagreeable. In all these points, the Automaton surpassed the most expert players on the pipe and tabor. The machine played complete airs, with rapid passages, which the best performers are compelled to slur over, and gave the requisite articulations of the tongue, at every note.

The same ingenious person made an artificial duck, which imitated, with astonishing precision, all the actions of the living animal. In its external form, the resemblance to its prototype, was perfect: its wings were anatomically exact in every part; not a bone in the body

of the original, and scarcely a feather, seemed to have been overlooked in this most accurate imitation. The automaton ate, drank, and quacked, in perfect harmony with nature. It gobbled food with seeming avidity, drank, and muddled the water, after the manner of the living bird. It not only swallowed. but appeared to digest, the food, and evacuated it, apparently changed in its nature.

Numerous writing figures have been exhibited, and the construction of them is well understood; the motion of the hand being directed by a concealed accomplice, who moves one limb of a pantograph, the other end of which terminates in the hand of the figure. The machine used for tracing profiles, are, ordinarily, of this kind. We have seen several such writing figures, but all much inferior to some which have been described. M. Droz, of Neufchatel, exhibited, in England, and elsewhere, a figure of a man, about the natural size. It held in its hand, a metal style, a card of vellum being laid under it; a spring was touched, which allowed the machinery to operate, it having been previously wound up; the figure then began to draw, and was capable of executing, with great elegance and precision, five or six different subjects, the cards being changed at proper intervals. M. Droz, after winding up the machine, left it for several hours in the care of Mr. Thomas Collinson, a scientific gentleman, after having explained to him the principal parts of the internal structure, and directed him how to use it. The first drawing contained likenesses of the king and queen, facing each other; and Mr. Collinson observes, that it was curious to see the precision with which the figure lifted up his pencil, in making its transitions from one point of the draft to another, without making the least slur whatever; passing from the forehead to the eye, the nose, the chin, or from the waving curls of the hair, to the ear. Mr. Collinson obtained five different drawings, in a way which proved clearly, that the whole was directed by the machinery.

An ingenious mechanician of Switzerland, M. Maillardet, likewise constructed a writing and drawing figure, which was operated upon by the machinery contained within itself. This consisted of the figure of a boy, kneeling upon one knee, and holding a pencil in his hand, with which he executed, not only writings, but also drawings, equal to those of the first masters. When the figure began to work, an attendant dipped the pencil in the ink, and fixed the paper; when, on touching a spring, the figure wrote a line, carefully dotting and stroking the letters. In this way, it executed four pieces of writing, in French and English, each consisting of several lines; it also made three different drawings of landscapes. The motions of the figure were fine imitations of those of animated existence.

A clock was made by M. Droz, which was presented to the king of Spain; besides a number of other moving figures, it contained that of a sheep, which imitated the bleating of that animal; and a dog, watching a basket of fruit: if any one attempted to purloin the fruit, the dog gnashed his teeth, and barked; and if it was actually taken away, he never ceased barking, until it was returned.

M. Maillardet, and M. Droz the younger, made, each of them,

gold snuff boxes, which, though of moderate dimensions, contained, concealed in one of their divisions, a small bird, only three-fourths of an inch in length, of green enamelled gold; this bird, on touching a spring, rose through a small opening in the box, wagged its tail, fluttered its wings, and, opening its bill, sent forth a song of surprising strength and harmony, continuing the whole time in rapid motion, and all its movements corresponding with the music. A box of this description is now in the possession of Mr. Gibbs, broker, of this city, which shows that the foregoing account is by no means exaggerated.

(TO BE CONTINUED.)

THE ARTISAN.—No. 3.

An explanation of the terms used in Chemical Science, with familiar exemplifications. By the Editor.

Among those books which have been professedly written in order to give instruction, in the first principles of science, to those who have not enjoyed the advantages of a regular education, there are but very few which possess the merit of having attained their object. It is in fact no easy task, for one who is himself perfectly familiar with the terms of science, and with the ideas which they are intended to convey, to sustain in his mind an adequate conception, and a constant recollection, of the ignorance on these points, of those whom he is attempting to instruct; yet this ignorance, every teacher should suppose, at least, to be complete, and he should never, for a moment, forget it.

We believe that nothing, but the habit of teaching, can give a full view of the truth of the above remark, and of the extent of those difficulties to which it alludes; this habit has convinced us, that notwithstanding the number of works which have been intended to teach the outlines of chemistry, there is not, in our language, one, which is sufficiently clear and familiar. Several of them are written by persons possessing, unquestionably, a competent knowledge of the subject, but who are not at all aware of all that is necessary to the learner; by far the greater number, however, are incorrect in point of fact.

We have made the preceding remarks in consequence of having felt, while selecting and preparing the materials for this Journal, a difficulty, similar to that of which we have been speaking. We have wished, most ardently, to be useful to practical men, and have published such articles as appeared most likely to promote this object; still, we have been fully aware that in these articles, a language is very frequently used, which, to many of our readers, must be obscure, if not unintelligible; we hope, however, in some measure to obviate this difficulty, by pursuing the plan proposed in the last number of '*The Artisan.*' Having there attempted a familiar illustration of the objects embraced by mechanical philosophy, and by chemistry,

we shall now proceed to an explanation of the most important terms in the latter science, with such exemplifications as may be likely to aid us in the accomplishment of our purpose.

Simples.—Compounds.—By the term *simple*, in chemistry, we mean, any substance, or body, which consists of only one ingredient; whilst by a *compound*, we intend, an article which is composed of two, or more, simples. The term *elementary substance*, is sometimes used in the same acceptation as simple: but we must be careful not to confound the term element, when thus used, with the *elements* of the ancient philosophers. At one period, fire, air, earth, and water, were accounted the elementary, or essential ingredients, of which all other bodies were composed: neither of these, however, has retained its ancient character; they are all now classed among the compounds, having long been, unequivocally, proved to be such.

Although the variety of compound substances is almost infinite, the number of simples, is comparatively small; not amounting, in the whole, to sixty, of which the metals make up about forty.

Decomposition.—Analysis.—Decomposition, is that change which takes place in any compound body, by which its nature is altered; in this case, it either loses the whole, or a portion, of one, or more of its component parts; or it acquires some new material, and is no longer the same body. To analyze a body, is to separate it into the simple, or elementary substances of which it is composed, with a view to ascertain its composition. We cannot analyze, or decompose a simple substance, because it contains only one ingredient. Whenever a body resists every effort to decompose it, and we have not good reason, from analogy, to conclude that it is a compound, it is classed with simple substances. Chemists, however, do not conclude that all the substances which they have so classed, are absolutely simple bodies, but only that they have not yet been decompounded, and that there is no strong analogy to justify the conclusion that they are compounds.

Synthesis is the reverse of analysis, as it signifies the taking the elements of which a substance is composed, and combining them together, so as to produce that substance. Water may serve as an example: this fluid, which is composed of *oxygen* and *hydrogen*, can readily be decomposed, and can as readily be reproduced, by causing oxygen and hydrogen to combine together. We thus obtain both an *analytical*, and a *synthetical* proof, that water is a compound.

Base.—This term is, in general, employed to denote the ingredient which gives to any compound, its particular, or most distinguishing character. Lime, is the base of those cements, which we denominate mortars. Clay, (*argil* or *alumine*,) is the base of the various kinds of earthenware. Iron, is the base of copperas (sulphate of iron,) which consists of iron united to sulphuric acid, (oil of vitriol.) Sulphur, is the base of sulphuric acid, which consists of sulphur united to oxygen.

Caloric.—The matter which produces heat. This term is used, to prevent that confusion which would result from employing the same term, to express two different things, and which does occur in the ordi-

nary use of the word heat; which we employ to indicate a certain sensation, and also, to denominate the article by which that sensation is produced. The propriety of introducing the term *caloric*, will be apparent, when it is known that this same agent, although it sometimes warms a body into which it enters, does not always produce this effect. Ice may serve to exemplify this.

Water, may exist in the form of ice, at a temperature of 32° of Fahrenheit's thermometer; if you take a lump of ice, of this temperature, into a warm room, it will begin to melt; and it is evident that this is in consequence of a portion of the matter of heat, passing into it; the water produced by the melted ice, must, therefore, contain more of the matter of heat, than the ice itself did; yet, if tested, the water will not indicate an increased temperature, nor will it begin to do so, until the whole of the ice is melted, although several hours may be required to effect this. It can be proved, by a direct experiment, that were a quantity of the matter of heat, equal to that which it absorbed while melting, to pass into it, after it is melted, its temperature would be elevated 140°. All this caloric is employed in converting it into, and retaining it in, the fluid state. We might, therefore, with evident propriety, say that the water contained more *caloric*, but not that it had more *heat* than the ice, the temperature remaining unchanged.

Latent Heat.—When caloric enters into a body, without elevating its temperature, it is then said to be *latent;* that is, it is concealed, or hidden. Thus the quantity which entered into the ice, in the example given, produced no alteration of temperature, but only changed the body from the solid to the fluid state; and, so far as temperature is concerned, was concealed or hidden in the water. The term latent heat, was in use before the word caloric had been adopted by chemists, and has, from habit, been continued, although it would evidently be more correct to say *latent caloric*, as the former expression is at variance with the reasoning which justified the adoption of the word caloric.

Free Caloric, or *sensible heat.* That caloric by the acquisition of which a body is heated, and by the loss of which it is cooled, we denominate free caloric, or sensible heat. It must be observed that we restrict the term sensible, in this case, to the sense of feeling, or to a change of temperature. In the example of the melting ice, we can *see* that a solid is changed into a fluid, but we cannot feel, or in any other way discover, a change of temperature.

Before water freezes, it sinks to the temperature of 32°; ice then begins to form, but until the whole of the water, contained in any vessel, be frozen, its temperature remains the same, however intensely cold the weather may be. The reason of this is, that every portion of it which becomes ice, has first to part with its *latent heat*, or that by which it was kept in the fluid form; this being now disengaged, becomes sensible, and therefore keeps up the temperature to 32°. If the quantity which is parted with by every portion of water which becomes frozen, could be suddenly communicated to an equal portion, in the fluid form, it would elevate its temperature 140°. It fol-

lows, therefore, that, could all the heat which is disengaged from a pint of water, in the act of freezing, be made suddenly to pass into a pint of water at 72°, it would cause it to be heated to 212°, or to the boiling point. This large quantity of heat which is disengaged, when water becomes ice, is the reason why the operation of freezing is a very slow one; the water is kept at 32°, by the heat, separated from that portion of itself, which is freezing; and this heat has to be carried off by the colder atmosphere, by which it is surrounded, before another portion can begin to freeze.

In the next number of the *Artisan*, we shall pursue this subject, and shall continue it until we have introduced all those substances and processes, the explanation of which may appear to us most likely to aid the artisan, in the acquisition of first principles. This department will not be restricted to chemical science, although to this will be allotted, a distinct and separate place.

Mechanics, and others, who desire information respecting *terms*, or *processes*, in the different departments of art or science, are invited to send their enquiries, which shall either be answered by us, or be inserted, in order to obtain answers from others.

On Chronometers and Expansion Curbs. *By* Benj. F. Baker.

TO THE EDITOR OF THE FRANKLIN JOURNAL.

Sir—In the third number of the first volume of the Franklin Journal, I gave a short paper upon the balance of chronometers, as operated upon by the atmosphere. Further observations, since that time, upon these instruments, have not in the least weakened the opinion, then expressed, upon the adjusting screws and loadings; but it is instantly asked, by the practical mechanician, In what way is the time to be preserved uniform, through greatly differing temperatures? The resort must necessarily be to the curb. Suppose, for example, the common lever curb, and flat hair spring; the pins of this curb are to be set so close together, as just to admit, freely, the spring between them; and are to be so shaped, that each pin will present to the spring, a very small surface. (say the edge of a triangle,) that, however long the vibration may be, only the same space upon the spring, will be touched by these pins. Let the chronometer be regulated, precisely as the lever now is, to a tolerable degree of accuracy, before the expanding and contracting attachment, is secured to it. This attachment must be made to act upon the curb itself, so that, when it expands by heat, it will move it (however little) along the index, towards the word *fast;* and the contrary way, towards the word *slow*, when it contracts by cold. This expansive appendage to the curb, may be made, or bent, into various shapes, in order to obtain an operative length of the compounded metals, and be simply screwed to the plate at one end, and to the curb at the other. The first inquiry naturally starting from the ideas of a practical man, will be, how to

bring about a proper quantity of action upon the curb, so as to only, and not more than, counteract the effects of heat and cold upon the timekeeper. This may be accomplished in various ways. Let the screw, that secures it to the plate, instead of passing through a round hole, pass through an oblong one; then, by drawing this screw a little, the end attached to the curb may be moved inwards, or outwards, thus, as it were, shortening, or lengthening, the lever acted upon. This will also be found convenient, when it is thought necessary to reduce the rate of the chronometer; for, by easing this screw, as in the first instance, the expansive attachment may be moved with the curb towards advance, or retard, sliding under the screw-head, it will preserve its relative bearing when again secured.

There are many other ways, by which the expansive curb may be made to act *parallel to the hair spring coil.* The above is given in explanation of the general idea; for it is the *principle* that I would illustrate and recommend, rather than any particular way of applying it. The objection to the expansive curb, now used in lever watches, is, that the action *crosses* the coil of the spring, and tends, as it were, to open, and close, the curb pins. The result will be, that when the curb is adjusted to different temperatures, (which can only be done by much care and observation, during cold weather,) while the oil is fresh in the pivot holes, and the vibration of the balance, long, the same relative effect on the time will not be produced, when the vibration shortens by the evaporation, or thickening of the oil. The expansive curb is generally to be found in all the highest priced lever watches, that come to this country; and yet, the writer never, in a single instance, found one that had been adjusted, even in the slightest manner, to different temperatures. Placed in the watch, merely to add a sounding epithet to its description, and a guinea to its price, they are not only utterly useless, but, in many instances, destroy the regularity of its performance. I have such a one in my shop at the present time, made at an establishment, equal, perhaps, in reputation, to any other. The expansive curb of this watch is so straight, that, at every vibration which opens the coil, the spring touches it nearly the sixteenth of an inch along the end that takes the place of the outer pin. This is so great an error, that it is impossible for the watch to perform with any proper degree of regularity; for every accidental shake it may receive, that widens the motion, the balance receives an additional impulse; and a diminished one, if the shake should shorten the action. I have been thus particular in noticing the ordinary expansive curb, from a belief, that foreign machinists must smile at our simplicity, in ordering, and paying for, a thing which is not merely useless, but injurious to the time of the watch that contains it.

The chronometer scapement, divested of its loaded balance, made, and placed with accuracy, and also with a view to prevent its setting, when used for the pocket, is, beyond all question, the best mechanical arrangement for a moveable time-keeper, that has been discovered. Completely detached in its action, the balance receives

its impulse directly from the crown wheel, at a distance from its pivots, nearly, or quite equal to, the whole space between the teeth of that wheel. In no other scapement, can this be accomplished. It is acted upon with less friction than any other, because the impulse given, follows more nearly the direction through which the balance moves, and, consequently, not being an angular rub, the points of the crown wheel teeth, will do perfectly well without oil; which is an important consideration. But the most general objection urged against the pocket chronometer, is, its liability to set, from being jolted, by riding on horseback, or otherwise. This is owing partly to the loaded balance, but mainly to the improper manner in which the scapement is arranged. I have seen many of them with the under pallet placed considerably out from the stem of the balance pinion; and the same pallet also stood so far round from the feather spring, when at rest, that it required a shake, throwing the balance through nearly half a circle, to start the chronometer; and its whole action, when going, did not reach a revolution. Such a watch could not, perhaps, be carried by an active person a single week, without stopping. This is an error of application, not of principle. The three pallets of a chronometer, together with the feather spring, can be so arranged, as that, by shaking the balance through *one-tenth* of a circle, the instrument will start. I have altered them to *one-eighth*, which is done by simply turning round the under, or striking off, pallet, so that, when the hair spring is at rest, that pallet will stand nearly parallel to the feather spring; then, by arranging the other parts, so that the scapement will act properly in accordance, a very slight motion will start the chronometer. With an *unloaded* balance, and a force of main-spring, equal to what is usually put into the lever, the vibration will, probably, reach a revolution and a third. What jolt, then, can possibly check such an action to the *tenth*, or even the *eighth*, of a circle?

BENJ. F. BAKER.

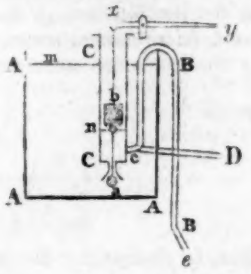
April 9th, 1827.

Description of an improved Syphon, and a Self-regulating Water Gate, for obtaining a regular and equable supply of Water, from Reservoirs, for Canals, and for other purposes. By S. H. LONG, *Colonel of Topographical Engineers.*

TO THE EDITOR OF THE FRANKLIN JOURNAL.

SIR—I take the liberty to communicate, for publication in your highly useful magazine, should you think it worthy of a place, a brief description of an improved Syphon, and Self-regulating Water Gate; either of which may prove serviceable, in draining water from reservoirs, for the supply of canals, and in other cases, where a regular and equable discharge of water is required. The plans under consideration, being analogous, and requiring nearly the same ad-

justments, a single figure, only, is sufficient to illustrate, respectively, their construction, and their mode of operation.



Let A, represent a cistern, or reservoir, filled with water to any height, as indicated by the dotted line at *m*, the contents of which are to be discharged agreeably to the plans suggested. B, a syphon, passing over the side of the reservoir, and communicating with a vertical trunk, placed within it. C, the trunk, of a diameter much greater than that of the syphon, and communicating with the latter, at *c*. The trunk is sustained in its vertical position, by supports attached to the side of the reservoir. At its lower extremity, is an orifice, of about the same diameter as that of the syphon, having a direction corresponding to that of the axis of the trunk. Within the trunk, is a float, or buoy, *b*, which must be allowed to move freely within it. The buoy is connected to a valve, or gate, *a*, of a globular or conical form, by means of an inflexible rod, or stem, of such a length as to allow the buoy to rise a little above the mouth of the syphon, at *c*. The valve, *a*, may be so adjusted, as to close the orifice at the bottom of the trunk, whenever the buoy is elevated to the top of its range, in order to intercept the discharge of the water, as occasion may require. To facilitate this operation, let a rod, or chain, *bx*, and a lever, *xy*, connected by the former, to the buoy, be appended to the apparatus, in any convenient manner, and the communication may be opened, and intercepted, at pleasure.

The operation will be as follows, viz. The trunk, C, and syphon, B, being filled with water, and the stopper removed from the end of the syphon, at *e*, the buoyancy of the water in the trunk, acting upon the buoy, *b*, will force the valve, *a*, into close contact with the rim of the orifice, at the bottom of the trunk, thereby preventing the admission of water, from the reservoir. As the water passes through the syphon, the trunk will be gradually exhausted, till the surface of the water contained in it, descends to *n;* when the buoy, being no longer sustained by the water, will act upon the valve, *a*, in such a manner, as to open the communication between the reservoir and the trunk. The water will now enter the trunk, through the orifice in its bottom, and the supply thus afforded, will correspond to the quantity discharged through the syphon.

In reference to the other modification, viz. the self-regulating gate,

the apparatus is similar, in all respects, to that just described, except that, instead of a syphon, a tube, or trunk, of about the same size as represented at *cD*, is to be substituted, communicating with the vertical trunk at *c*, and leading through the side of the reservoir, in a direction, horizontal, or inclining downward. The operation in this case, is so directly analogous to that in the former, as to require no further illustration.

I am, sir, &c. S. H. Long.

April 20th, 1827.

FOR THE FRANKLIN JOURNAL.

On the effect of Heat, in facilitating the cutting of a Razor.

Mr. Editor—It has been asked, in several of the English Mechanics' Magazines, "Why does a razor cut best, after dipping in hot water?" to which I have seen no satisfactory answer, though many attempts have been made. One considers the edge of a razor as toothed like a saw, and the expansion of the steel, by heat, to have some unaccountable effect on these teeth. Another, found that the heat of a coal fire would do as well as that of hot water; and another pretends to discredit the fact altogether. May not this question be partially answered, by asking another, Why does a hot knife, cut butter easier than a cold one?

Let any one shave with a cold razor, and examine it before wiping, he will perceive a wall of wax-like matter along the edge, which limits its free action to a mere line, similar to the edge of a double-iron plane; this wall is made soft by heat, and is removed by each succeeding cut. A razor, then, in addition to its property of cutting the beard freely, requires that of discharging the adhesive matter scraped up from the skin; this last property is very conveniently acquired, by dipping in hot water.

Yours, &c. Cogitator.

Remarks by the Editor.—We have long been convinced, that the cause assigned by *Cogitator*, is the true one, and have repeatedly given a similar solution. We have also met with the same explanation in one of the English journals, probably in the London Mechanics' Magazine. In order to test its truth, we have shaved with a cold razor, which, during the operation, was repeatedly dipped into cold water, and wiped upon a napkin, and are certain, that the keeping of the edge clean in this way, was advantageous. With respect to those who have doubted the correctness of the opinion, that warmth facilitates the cutting of a razor, we think that they have neither tender chins, nor stiff beards; otherwise, their doubts would have been removed with the removal of the latter.

The communication of *Cogitator*, has been for some time in our possession, but was mislaid, or it would have received an earlier insertion.

Animadversions on some Remarks upon Friction, in the description of Thomas's Marine Rail-way.

TO THE EDITOR OF THE FRANKLIN JOURNAL.

SIR—On looking over the description of Mr. Thomas's marine rail-way, in the Franklin Journal, my attention was arrested by the remark upon friction; "however true, theoretically," says the author, "that the friction must be diminished by large wheels and small axles, yet in the treatises of both Tredgold and Wood, it is admitted to be so inconsiderable, that the principle is established in practice, that the friction is as the weight—velocity does not increase it," &c. As I did not happen to coincide in that opinion, I immediately looked for the usual "remarks by the editor," which, by the by, I always read with peculiar satisfaction, but finding him silent, and, certain that he had not been napping, I concluded that I had been in error, and that *theory* and *practice* were never lawfully joined together. I therefore soon reasoned myself into the belief that friction wheels, might have their axles larger, even, than the *wheels* themselves.

It is a law of friction, that it exerts a constant force for all velocities;* now, as the degree of force expending, is the same for all velocities, both in the action and reaction, it follows, *that the whole amount of moving power expended, is as the time elapsed*, and that the weighing machine, or any fixed point that sustains the re-action, is under the same expense of power, since the time is the same, at both ends of the draft.

Were the position assumed by Mr. S. correct, we might find the quantity of metal in a piece of wire, if of uniform thickness throughout, by multiplying the area of the section, by the time of running the length of it, without regard to velocity. If such be the fact, it remains inexplicable how the use of friction wheels, came to be introduced at all, since there is not, *even in theory*, a good reason for it. But, after all, sir, I fancy that at least one half of our learned philosophers, will doubt the truth of this astonishing doctrine.

I am, sir,
Most respectfully yours, &c.
AN OPERATIVE MECHANIC.

Remarks by the Editor.—The remarks of Mr. Sullivan upon friction, to which our correspondent alludes, will be found in page 81 of this volume; it appears to us, that they are incorrect; as we think that not only theory, but practice, uniformly leads to the conclusion, that the effect of friction is diminished, in a very considerable degree, by large wheels, and small axles. It is fully admitted, that the retarding force of friction, is as the load, (nearly,) *all other*

* This has been most satisfactorily shown, by *weighing* the *re-action* which is in all cases equal, in point of energy, to the action, and therefore its just representation. See London Mechanics' Magazine, experiments by Roberts.

circumstances remaining the same. TREDGOLD, and WOOD, are referred to, as authorities to prove that the size of the wheels is unimportant; we have again looked into their treatises on rail roads, and do not understand them, if they justify the assumption, that the resistance is not considerably lessened, by the employment of large wheels.

We did intend, to have given in the present number, a more extended article upon this subject, but find that we have now neither time, or room, and therefore defer it until another opportunity; we have detained 'An Operative Mechanic,' that his letter, and our remarks might accompany each other, but as we are very anxious to encourage our *operatives* to write, we give a place to his communication, although we must reserve our own observations for a future period.

PERKINS'S STEAM ENGINE.

PUBLIC expectation has been kept so long on tiptoe, to view the promised results from this "*miracle of arts,*" and hope has been so long deferred, that it would be matter of surprise, were not all new promises upon the subject, listened to, very doubtingly. We present to our readers, the two following articles, which are the most recent we have seen upon this subject, and which, it will be perceived, are written in a tone of great caution. For ourselves, we never looked for the fulfilment of the promises which were at first made, because we knew of no principle, in mechanical or chemical philosophy, upon which they could be sustained; and in these principles, we were not prepared for any sudden and great revolutions. [*Editor.*

So much has been said by us, and reiterated by our contemporaries, relative to Perkins's projected improvements on the steam engine, and so little produced, of a nature calculated to satisfy public expectation, that it is with no small degree of diffidence we again mention the subject. We consider, however, that it is our duty, as public journalists, and particularly so, as standing foremost in the ranks of mechanical science, to present our readers with every glimmer of light, that may afford the prospect of rekindling the embers of this important subject.

Mr. Perkins has now completed an engine, which he represents as embracing the ultimatum of his present intentions, and which is designed to show the absolute realization of his anticipated hopes, or their decided failure. We should, however, observe, that the possibility of the latter, Mr. P. has never for a moment admitted, and now considers that he has only perfected those plans he contemplated from the first, and which required but patience and time, to bring to maturity.

The very transient view of the engine, which we have been enabled to take, precludes the possibility of our describing its construction; besides, we should, by so doing, anticipate a more perfect account,

which we hope to give, hereafter. There are many parts, which exhibit considerable novelty and ingenuity, and the whole is comprised in a very compact form. The power of the engine, which stands upon a base of about four feet square, is said to be capable of variation, from fifteen, to thirty horses, according to circumstances, connected with the economization of fuel. It has not yet been exhibited in operation, but that is expected to take place in a few days.

At present, we beg to be understood, as merely reporting progress, and not in any respect as venturing an opinion as to the result: we have only seen the engine for a few minutes, in a state of inertia; by the time of publishing our next number, we, probably, shall be in a situation to say something that may be satisfactory, if not final.

[*Lond. Journ. of Arts & Sciences.*

Perkins's high-pressure Engines.

A report has been made by M. Girard, on a memoir by Sir Wm. Rawson, on Perkins's high-pressure engines, read to the Academy of Sciences at Paris. The report, after enumerating the advantages, stated in the memoir to be possessed by the apparatus, observes, how desirable it would be, that these assertions should be supported by authentic experiments, which, it appears to them, they want at present, unless it be in the propulsion of balls, which comprises the whole of the official proofs. [*Bull Univ. p. 257.*

On the preparation of Hydraulic Cements. By General Treussart.

General Treussart, referring to some observations, published at St. Petersburgh, in 1822, by M. Raucourt, and to some experiments of his own, related, in a late number of the *Memorial de l'officier de Génie*, states, that he has, since then, established an important fact, which he had previously been led, by Raucourt's remarks, to anticipate, with regard to the preparation of artificial pozzolan-mortar, or hydraulic cement; namely, that the access of air, during the calcination of the argillaceous cement, is of great consequence to the tenacity of the mortar, and the quickness with which it hardens. He first refers to his former experiments, (which we have not yet seen,) as proving, that, contrary to what is generally supposed, neither the oxide of iron, nor that of manganese, nor magnesia, can communicate to lime, the property of hardening under water. He then observes, that, on calcining an argillaceous earth, procured near Frankfort, (and consisting of silica and alumina, a 66th part of magnesia, and a trace of iron,) and mixing it with half its weight of lime, to form a mortar, he found, that, if it had been calcined under free exposure to the air, it hardened under water, in two or three days; and, at the end of a year, required a weight varying from 390 to 530 pounds to break it; while, if the clay had been calcined out of reach of the air, the mortar took thirty days to harden, and broke with a weight of 40 or 50 pounds. Analogous results were obtained with a clay from

Holzheim, near Strasburg; and in this instance, he also found that it was useful to mix a fiftieth part of lime with it, before calcination. It is not easy to account for these differences; but the general himself, is disposed to ascribe them to the absorption of oxygen, by the alumina. In proof of this, he mentions, that the same difference is observed, if, instead of impure clay and lime, the purest alumina, and the lime of white marble, be employed. The alumina, when calcined under a current of air, makes a mortar which hardens sooner, and is much stronger, than when the calcination is conducted in a close furnace. Another fact in support of his conjecture, is, that alumina, when calcined in the air, dissolves more easily in sulphuric acid. The results of his latest investigations, are, that the clay to be chosen for the best hydraulic mortars, should contain a little lime; that it should be calcined under exposure to a current of air, contrived according to the nature of the furnace; that, after being reduced to a fine powder, it should be mixed with paste of lime, in the proportion of one of the latter, to two, or two and a half, of the former: that the mortar should be kept for ten or twelve hours before it is used, in order to acquire a certain degree of consistence; and that it may be perfectly relied on, if, by a preliminary trial, it is found to harden in three or four days; his experience having invariably shown, that the mortars which harden soonest, are also the most tenacious.—*Annales de Chimie et de Physique, Mars*, 1826.

Composition for the Covering of Buildings, by M. Pew.

The composition proposed by the author, is destined to form a sort of unalterable, and incombustible mastich. For this purpose, he takes the hardest, and the purest limestone that he can find, free from sand, clay, or other heterogeneous matter. White marble is to be preferred, if it can be procured. The limestone is calcined in a reverberatory furnace; it is then pulverized, and passed through a sieve. One part is taken by weight, and mixed with two parts of clay, well baked, and similarly pulverized. This mixture must be made with great care. On the other hand, one part of calcined and pulverized sulphate of lime (gypsum,) is taken, and two parts of clay, baked, and pulverized, added to it. These two sorts of powder are then combined and incorporated, so as to produce a perfect mixture. The composition is preserved for use in a dry place, sheltered from the air, where it keeps for a long time, without losing its properties. When it is to be used, it is mixed with about a fourth part of its weight of water, which is gradually added, stirring it continually, until it forms a thick paste. This paste is spread upon the laths, and joists of buildings, which it renders entirely incombustible. It becomes, in time, as hard as stone; allows no moisture to penetrate, and is not cracked by heat. When well prepared, it will last for any length of time. The composition, when still in a plastic state, will receive whatever colour it may be thought proper to give it.

Strong Leather for Harness, and other Saddlery work.

In Poland, and Russia, the twisted leather which they make themselves, is preferred to every other kind, for harness. For making this leather, dried cow-hide is taken; the hair is removed by means of boiling water, and a sort of scraper; it is then cut into long straps, which are sewed, end to end; the two extremities of the long strap thus formed, are then stretched together, and the strap thus becomes double. In this state, it is impregnated with fatty substances, made warm; it is then suspended by a hook, to the roof, and weights attached to its lower part. In this manner, the strap forms two parallel bands, placed in a vertical position, and united above and below. Two sticks are passed between them, crossed horizontally; and they are twisted, and pressed against each other, as strongly as possible; and when the moving power ceases, they turn of themselves in the opposite direction. During this operation, the leather is very sensibly heated; fatty substances are then applied to it anew, with which it is fully impregnated, and at length acquires an extraordinary degree of pliancy. The leather thus prepared, lasts for a very long time, and preserves its qualities in all sorts of weather.

Bull. Univ. August, 1825.

Cows, Horses, and Sheep, fed on Fish, in Persia.

The cows have humps, and resemble those of India; milk, butter, and ghee, are very abundant, and good of their kind. This is the more remarkable, as the cattle have but little pasture in the neighbourhood of the town; and it is certain, that one chief article of their food is *dried fish*, a little salted; the cattle become very fond of this, which, with pounded date-stones, is all they get to eat for a considerable portion of the year. The natives assert, that, so far from the milk being spoiled when the cattle feed on these things, they drink much more water, which increases both the quantity and quality of the produce. Horses, and sheep, as well as cows, are fed on this diet, and thrive equally well upon it. [*Fraser's Travels.*

Manufacture of a Paper, which has the property of removing Rust from articles of Iron and Steel.

After having dried a certain quantity of pumice among live coals, and reduced it to powder, grind it with linseed oil varnish, and then dilute it with the same varnish, until it be thin enough to be laid upon paper, with a pencil. To give this layer a yellow, black, or brownish-red colour, the mass is mixed, before applying it to the paper, with a little ochre, English red, or lamp-black. Care must be

taken to lay the substance on as equally as possible, and to dry it in the air. When the first coat, thus applied to the paper, is dry, another is to be laid on, in like manner. Those who manufacture it for sale, pass the paper, thus prepared, under a cylinder, to render it smooth. It is further to be observed, that the mass must be liquid, and that it must be stirred about, before applying it to the paper.

LIST OF PATENTS IN ENGLAND.

Which passed the Great Seal in December, 1826.

To John Costigan, of Collon, in the county of Louth, in that part of the United Kingdom, called Ireland, civil engineer, for his invention of certain improvements in steam machinery or apparatus—18th December.

To Peter Mackay, in the county of Surrey, gentleman, in consequence of a communication made to him by a foreigner residing abroad, that he is in possession of an invention of certain improvements by which the names of streets and other inscriptions will be rendered more durable and conspicuous—18th December.

To William Johnson, of Droitwich, in the county of Worcester, gentleman, for his invention of certain improvements in the mode of process, and form, of apparatus for the manufacturing of salt, and other purposes—18th December.

To Maurice De Iongh, of Warrington, cotton spinner, for his invention of certain improvements in machinery or apparatus for preparing rovings, and for spinning, twisting, and winding fibrous substances—18th December.

To Charles Harsleben, in the county of Middlesex, Esq. for his invention of certain improvements in constructing or building of ships, and other vessels, applicable to various useful purposes, and in machinery for propelling the same—20th December.

To Thomas Quarrill, in the city of London, lamp-manufacturer, for his invention of certain improvements in the manufacture of lamps—20th December.

To William Kingston, master mill-wright, and George Stebbing, mathematical instrument maker, of Portsmouth, for their invention of certain improvements on instruments or apparatus for the more readily, or certainly, ascertaining the time and stability of ships and other vessels—20th December.

To Melvil Wilson, in the city of London, merchant, in consequence of a communication made to him by a certain foreigner residing abroad, he is in possession of an invention of certain improvements in machinery for cleaning rice—20th December.

To Charles Seidler, in the county of Middlesex, merchant, in consequence of a communication made to him by a foreigner resident abroad, for having discovered a method of drawing water out of mines, wells, pits, and other places—20th December.

To Frederick Andrews, in the county of Essex, gentleman, for his invention of certain improvements in the construction of carriages, and in the engines, or machinery to propel the same, to be operated upon by steam, or other suitable power, which engines or machinery are also applicable to other purposes—20th December.

To Charles Random Baron de Borenger, of the county of Middlesex, for his having discovered and invented certain improvements in gunpowder-flasks, powder-horns, or other utensils, of different shapes, such as are used, or can be used, for the purpose of carrying gunpowder therein, in order to load therefrom, guns, pistols, blunderbusses, and other fire-arms—20th December.

To Valentine Bartholomew, in the county of Middlesex, gentleman, for his invention of improvements in shades for lamps, and other lights—21st December.

To John Gregory Hancock, in the county of Warwick, plated beading and canister-hinge manufacturer, for his invention of a new elastic rod, for umbrellas and other the like purposes—21st December.

French Patents, 1826.

To A. Dutertre, Paris, for his invention of a new instrument to the use of sight. 9th June—15 years.

De Bugury, and Bernhardt, Paris, for their invention and importation of a certain process to produce artificial leather. 16th June—10 years.

Baroness de Gavedell-Geanny, Paris, for her importation and improvement of manufacturing bricks by machinery. 16th June—15 years.

V. L. Simonard, Lyons, Department Rhone, for his addition and improvement to his patent for a mechanical process of driving boats up the river by the current. 21st Dec. 1825—15 years.

G. Hunter, Paris, for his invention of a carriage, carrying its own iron rail road. 16th June—15 years.

P. Fouquier, Roubaix, for his invention of a manufacturing weaver combs of steel. 16th June—5 years.

J. B. V. Buisson, Paris, for his invention of a process for bleaching and washing linen by steam. 16th June—10 years.

B. Laboyer de St. Gervaix, Paris, for his invention of a machine he calls "Voltige." 16th June—10 years.

C. P. Antheaum, Rouen, Department Seine inferieure, for his invention to sew, mechanically, shoulder straps, &c. 26th June—5 years.

L. Baron, Nimes, Department Gard, for his improvement and addition to his patent of invention for a distilling apparatus. 23d June—5 years.

H. Brugniere, Nimes, Department Gard, for his invention of improvements to M. Derosnes' distilling apparatus. 23d June—5 years.

P. Daste, Condon, Department Gers, for his invention of a machine to grind corn. 23d June—5 years.

P. Vital, Paris, for his invention of a process to learn to write in a short time. 23d. June—5 years.

A. N. Lithomond, Paris, for his invention of a process to manufacture artificial marble, stone, and ornaments thereof. 23d June—15 years.

M. Poole, London, for his invention to tan leather by the compression of the atmosphere. 23d June—15 years.

J. Hayward, Paris, for his invention of a new apparatus to filter and clarify sirups, &c. 23d June—5 years.

E. Fessart, Paris, for his invention of a tool to clean bottles. 30th June—10 years.

J. Suttil, London, for his importation of a set of machinery to spin hemp, flax, &c. 30th June—15 years.

A. Brouguiers, La Rochelle, Department Charente inferieure, for his improvement and additions to his patent for a distilling apparatus. 11th Dec. 1817—10 years.

NOTICES.

Eau de Javelle.—This liquid, which is mentioned in the article on the "Manufacture of Catgut," &c. is a weak bleaching liquor, employed in Paris, not only in manufactories of several kinds, but also in domestic economy. The bleaching salts (chlorate of lime), made and sold in this city, may be used wherever a liquid similar to the *eau de Javelle* is wanted, and it may be graduated to any desired strength.

The article on Japanning and Varnishing, which has been omitted in several numbers, we hope to resume in the next.

We had prepared an article on the Baltimore Rail Road, and the Pennsylvania Canal, but our forms were filled, and it has been crowded out.

It has been suggested, that it would be an improvement, to place the titles of the respective articles at the head of each page, instead of the present running title; we will adopt this plan at the commencement of the next volume.

Errata.—In page 286, of this number, line 18, from the bottom, for "the plan of forming," read *other modes of forming*. In the same line, after "connexion." insert *were suggested*.

For Abraham Pennock, read Abraham L. Pennock.